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NATIONAL DAM INSPECTION PROGRAM. KENNAMETAL RESERVOIR DAM. (NDI--ETC(U)
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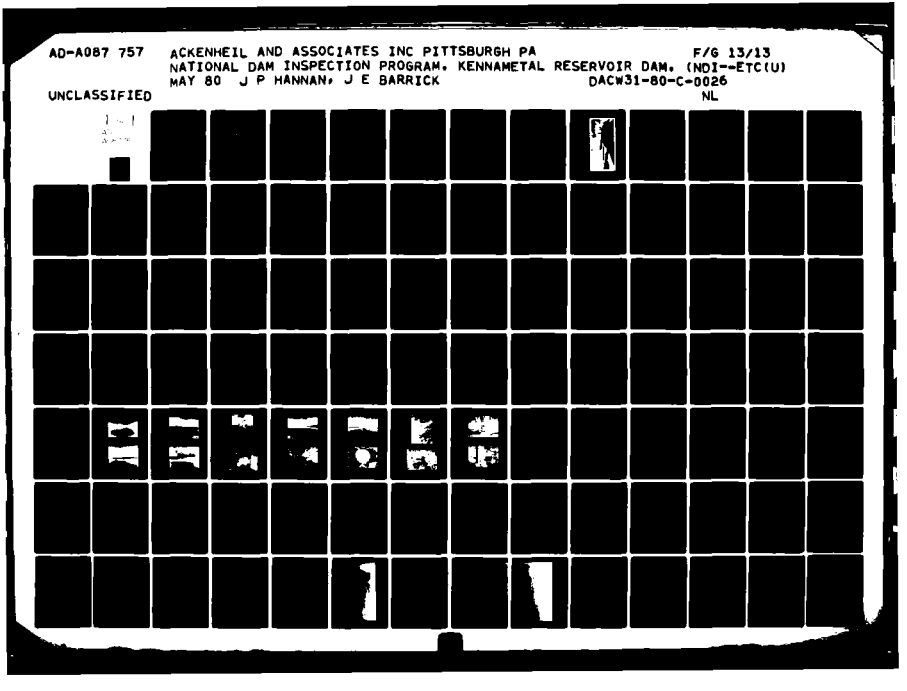

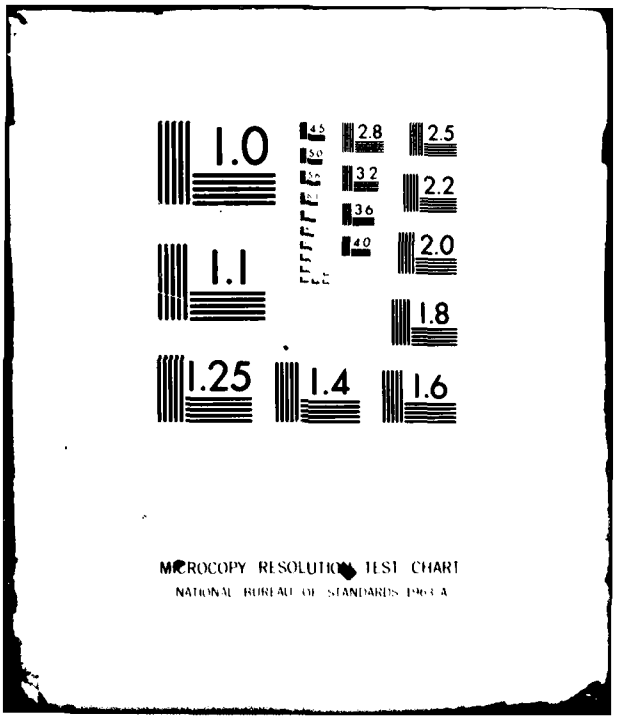
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OHIO RIVER BASIN
MILLER RUN
WESTMORELAND COUNTY

PENNSYLVANIA

NDI No. PA 00482
PENN DER No. 65-120

KENNAMETAL RESERVOIR DAM

KENNAMETAL INC.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

ACKENHEIL & ASSOCIATES
DACW31-80-C-0026

PREPARED FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
BALTIMORE, MARYLAND 21203

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ACKENHEIL & ASSOCIATES GEO SYSTEMS, INC.
CONSULTING ENGINEERS
1000 BANKSVILLE ROAD
PITTSBURGH, PENNSYLVANIA 15216

MAY 1980

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(6) National Dam Inspection Program
Kennametal Reservoir Dam
(NDI Number PA-00482
Penn DER Number 65-120)

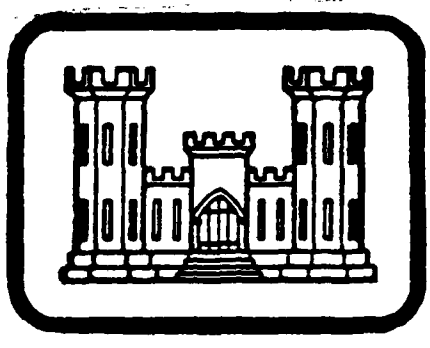
(1)

OHIO RIVER BASIN, Miller Run,
Westmoreland County, Pennsylvania

KENNAMETAL RESERVOIR DAM
WESTMORELAND COUNTY, COMMONWEALTH OF PENNSYLVANIA
NDI NO. PA 00482
PennDER NO. 65-120.
KENNAMETAL, INC.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

(10) James P Hannan James T. Eaton



(15) DACW31-80-C-0016

Prepared for: DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

Prepared by: ACKENHEIL & ASSOCIATES GEO SYSTEMS, INC.
Consulting Engineers
1000 Banksville Road
Pittsburgh, Pennsylvania 15216

(12) 95

Date: 11 May 1980

4/11 285

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I investigations. Copies of these guidelines may be obtained from the Department of the Army, Office of Chief of Engineers, Washington, D.C. 20314.

The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon visual observations and review of available data. Detailed investigations and analyses involving topographic mapping, subsurface investigations, materials testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for such studies which should be performed by the owner.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external factors which are evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some time in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" (PMF) for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS

NAME OF DAM:	Kennametal Reservoir
STATE LOCATION:	Pennsylvania
COUNTY LOCATION:	Westmoreland
STREAM:	Miller Run, a tributary of Loyalhanna Creek
DATE OF INSPECTION:	27 November 1979, 3 April 1980
COORDINATES:	Lat. 40°18'08" Long. 79°18'39"

ASSESSMENT

Based on a review of available design information and visual observations of conditions as they existed on the date of the field inspections, the general condition of the Kennametal Reservoir Dam is considered to be good.

The structure is classified as a "small" size, "high" hazard dam. Corps of Engineers guidelines recommend 1/2 to one times the Probable Maximum Flood (PMF) for "small" size, "high" hazard dams. Kennametal Reservoir Dam's Spillway Design Flood is 1/2 the Probable Maximum Flood (PMF). Spillway capacity is "inadequate" because the non-overtopping flood discharge capacity, as estimated using the HEC-1 computer program, was found to be 13 percent of the PMF. The spillway is not "seriously inadequate" because failure of the structure would not significantly increase the flood stage and risk of loss of life downstream.

The visual inspection indicated minor deficiencies which are considered correctable. The deficiencies can be eliminated through implementation of the following recommended remedial, monitoring and/or maintenance efforts.

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)
Kennametal Reservoir Dam

RECOMMENDATIONS

1. Additional Investigations: Immediately retain a professional engineer knowledgeable in dam design and construction to:

a. Perform a detailed hydrologic/hydraulic analysis of the reservoir and spillway and make recommendations on increasing the capacity of the system to make it adequate.

b. Evaluate the operability of the upstream flow controls for the water supply and pond drain pipelines.

c. Inspect the seeps in the pond drain discharge channel and at the pond drain outlet and inspect the sinkholes on the terrace above the pond drain discharge channel and provide recommendations for monitoring and/or control.

2. Remedial Work: The Phase I investigation of Kennametal Reservoir Dam also disclosed several deficiencies of lower priority which should be corrected during routine maintenance.

a. Divert surface runoff flows away from the right end of the embankment.

b. Revegetate the embankment crest and downstream slope.

c. Develop and implement formal maintenance and inspection procedures.

3. Emergency Operation and Warning Plan: Concurrent with the additional investigations recommended above, the owner should develop an Emergency Operation and Warning Plan including:

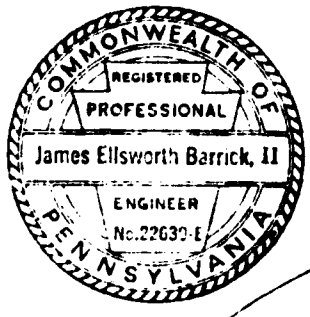
a. Guidelines for evaluating inflow during periods of heavy precipitation or runoff.

b. Procedures for around the clock surveillance during periods of heavy precipitation or runoff.

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)
Kennametal Reservoir Dam

c. Procedures for drawdown of the reservoir under emergency conditions.

d. Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.



James P. Hannan 23 May 1980
James P. Hannan Date
Project Engineer

James E. Barrick 23 May 1980
James E. Barrick, P.E. Date
PA Registration No. 022639-E

Approved by: 30 JUNE 1980
JAMES W. PECK Date
Colonel, Corps of Engineers
District Engineer

KENNAMETAL RESERVOIR DAM

OVERVIEW

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
KENNAMETAL RESERVOIR DAM
NATIONAL I. D. NO. PA 00482
PennDER No. 65-120

SECTION 1
PROJECT INFORMATION

1.1 GENERAL

a. Authority: The Phase I investigation was performed pursuant to authority granted by Public Law 92-367 (National Dam Inspection Act) to the Secretary of the Army through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose: The purpose of the investigation is to make a determination on whether or not the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Dam and Appurtenances: Kennametal Reservoir Dam consists of an earthfill embankment and an open channel spillway located on the left abutment.

(1) Embankment: The embankment is constructed of clay and has a reinforced concrete core wall extending the length of the dam. The embankment is 210 feet long, has a crest width of 10 feet, and has a downstream slope of 6.8H:1V.

(2) Principal (and Emergency) Spillway: The principal (and emergency) spillway for the dam is a weir controlled, open channel, constructed of reinforced concrete on the left abutment. The spillway is 40 feet wide at the weir crest and has a freeboard of 3.2 feet. The approach and discharge channels, which are formed by concrete walls, are 5 feet deep and have rectangular cross-sections. Both channels have concrete slab pavement.

(3) Outlet Works: Two pipelines were constructed through the embankment. One is a concrete encased 24 inch diameter CMP, which provides a pond drain for the impoundment. The other is an 8 inch diameter transite pipe that supplies water to Kennametal, Inc. plants downstream.

Inlets for both pipes are located at a reinforced concrete intake structure at the upstream toe of the embankment. Both pipelines have upstream flow controls.

(4) Downstream Conditions: Miller Run, below Kennametal Reservoir Dam, passes through a relatively narrow and steep sided valley for the first half mile. Below this, the valley is somewhat wider and the slopes not as steep. In the final 0.75 miles before the stream discharges to Loyalhanna Creek, the valley narrows and steepens once again. There are approximately 35 inhabited dwellings in the 3 mile reach between the dam and Loyalhanna Creek.

b. Location: Kennametal Reservoir Dam is located across Miller Run in Derry Township, Westmoreland County, Pennsylvania. Miller Run is a tributary to Loyalhanna Creek which joins the Conemaugh River at Saltsburg, Pennsylvania to form the Kiskiminetas River.

c. Size Classification: The dam has a storage capacity of 14 acre-feet at the embankment crest and a maximum toe to crest height of 35 feet. Based on this criteria, the dam is classified as a "small" size structure.

d. Hazard Classification: Kennametal Reservoir Dam is classified as a "high" hazard dam. In the event of a dam failure, at least 35 inhabited dwellings and considerable commercial development on the flood plain below the dam would be subjected to substantial damage and loss of life could result.

e. Ownership: Kennametal Reservoir Dam is owned by Kennametal, Inc., Latrobe, Pennsylvania. Correspondence should be addressed to:

Kennametal, Inc.
1 Lloyd Avenue
P.O. Box 231
Latrobe, Pennsylvania 15650
Attn: Mr. Henry J. Findish, Supervisor
(412) 539-5451

f. Purpose of Dam: Kennametal Reservoir Dam provides water for industrial use and fire protection at nearby Kennametal plants.

g. Design and Construction History: Kennametal Reservoir Dam was designed by Walter S. Thomas for Kennametal, Inc., to impound water for industrial use and fire protection. It was constructed in 1957 by Dill Construction Company of Latrobe, Pennsylvania.

h. Normal Operating Procedure: Kennametal Reservoir Dam operates as an uncontrolled structure not requiring a dam tender. Under normal operating conditions, pool level is maintained at Elev. 1496.8 by the crest of the spillway weir.

1.3 PERTINENT DATA

a. Drainage Area: 1.2 sq. miles

b. Discharge at Dam Facility:

Maximum Flood at Dam Facility	Unknown
Principal (Ungated) Spillway Capacity at Minimum Top of Dam	319 cfs

c. Elevation: (Feet above MSL)**

Design Top of Dam	1500*
Current Top of Dam (Low Point)	1498.6
Normal Pool	1496.8*
Maximum Tailwater	Unknown
Inlet Invert of Pond Drain	1480 ±*
Downstream Invert of Pond Drain	1465 ±*
Streambed at Toe of Dam	1465 ±*

d. Reservoir Length:

Length of Maximum Pool	350 feet
Length of Normal Pool	310 feet

e. Storage:

Current Top of Dam	14 acre-feet
Spillway Crest	11 acre-feet*
Normal Pool Level	11 acre-feet*

f. Reservoir Surface:

Current Top of Dam	1.3 acres
Spillway Crest	0.9 acres*
Normal Pool	0.9 acres*

g. Embankment:

Type	Clay with reinforced concrete core*
Crest Width	10 feet
Length	210 feet
Height	35 feet*
Slopes	
Upstream	3H:1V*
Downstream	6.8H:1V
Cutoff provisions	Concrete wall*

h. Outlet Works (Water Supply Pipeline):

Type	8 inch transite pipe
Inlet Elevation	± 1480*
Upstream Flow Control	Yes
Conduit Length	126 feet*
Gate Valve	Yes
Anti-seep Collars	No*

i. Outlet Works (Pond Drain):

Type	24 inch diameter CMP
Inlet	Through inlet port in valve house tower
Upstream Flow Control	Yes
Conduit Length	135 feet*
Gate Valve	Yes
Anti-seep Collars	No*

j. Spillway:

Type	Open channel with control weir
Crest Width of Weir	1 foot
Crest Elevation	1496.8 feet**
Crest Length	40 feet
Gate	None
Discharge Channel Slope	18%

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*Taken or derived from design information in PennDER files.

**To obtain elevations shown on design drawings in Appendix E, subtract 60 feet.

SECTION 2
ENGINEERING DATA

2.1 DESIGN

a. Data Available: The following written information and data may be obtained from the Pennsylvania Department of Environmental Resources, Harrisburg, Pennsylvania. This information was reviewed for this study.

(1) "Report Upon the Application of Kennametal, Inc." prepared by Water and Power Resources Board, Department of Forest and Waters, Commonwealth of Pennsylvania, and dated Harrisburg, 4 April 1957.

(2) Two design drawings by Walter S. Thomas, dated April and June 1957.

(3) One inspection report, dated 23 April 1964, by Division of Dams and Encroachments personnel.

b. Design Features:

(1) Embankment: The embankment was designed to be 35 feet high and 210 feet long and constructed of clay, compacted in six inch layers. The crest was to be 10 feet wide with upstream and downstream slopes of 3H:1V. A reinforced concrete core wall was designed to extend from four feet below the crest to a variable depth (9 feet to 15 feet scaled) into the foundation. The wall thickness varied from two feet at the top to five feet at the base. Two inch diameter iron pipes were embedded through the full depth of the core wall on 20 foot centers.

(2) Principal Spillway: The principal (and emergency) spillway was designed as a reinforced concrete lined open channel, 40 feet wide and 5 feet deep on the left abutment. The discharge channel was a reinforced concrete slab approximately 50 feet long, with discharge below to a riprap lined channel.

(3) Outlet Works: A reinforced concrete "valve house base" intake structure was designed to provide an inlet for the pond drain and water supply pipeline. The valve house and base were located in the reservoir near the upstream toe of the embankment. Access was by a "catwalk" from the embankment crest.

The pond drain was to be constructed of 24 inch diameter CMP, encased in concrete, and was to discharge below the embankment at a concrete headwall. The design flow control was to be at the intake structure.

The water supply pipeline was to be 10 inch diameter cast iron, laid "through breast" of the embankment. As with the pond drain, flow control as to be at the intake structure.

The intake structure was designed with three rectangular, screened and gated, inlet ports near the bottom of the reservoir. The port gates were to be controlled by valve stems that extended into a concrete block valve house above.

2.2 CONSTRUCTION

a. Constructor: According to Kennametal, Inc. personnel, the dam was constructed in 1957 by Dill Construction Company of Latrobe, Pennsylvania.

b. Modifications: According to Kennametal, gate valve controls were added on the upstream side of the embankment for both the pond drain and water supply pipelines, presumably during construction. Also, the water supply pipeline installed was 8 inch diameter transite instead of 10 inch diameter cast iron. Field observations presented in Section 3 confirmed a pond drain gate valve stem riser on the embankment crest. The water supply line gate valve control was reported to be inside the valve house and was not observed.

Another modification observed during the site inspection was a concrete weir, 1.8 feet high,in the principal spillway channel. The date of installation of the weir was not known.

2.3 OPERATION

Kennametal, Inc., Latrobe, Pennsylvania is responsible for the operation of Kennametal Reservoir Dam. The only operational features at the dam are valves and gates used to regulate flow into the pond drain and water supply pipelines.

2.4 EVALUATION

a. Availability: Available design information and drawings were obtained from the Pennsylvania Department of Environmental Resources and discussions with Mr. Henry J. Findish, Supervisor, Kennametal, Inc., Latrobe, Pennsylvania.

b. Adequacy: The available design information supplemented by field inspections, discussions, and supporting engineering analyses presented in succeeding sections, is adequate for the purpose of this Phase I inspection report.

c. Validity: Based on the available data, there appears to be no reason to question the validity of the available design information and drawings.

SECTION 3
VISUAL INSPECTION

3.1 FINDINGS

a. General: The visual inspections of Kennametal Reservoir Dam and impoundment were performed on 27 November 1979 and 3 April 1980, and consisted of:

(1) Visual observations of the earth embankment crest and slopes, groins and abutments.

(2) Visual observations of the spillway including weir wall, training and wingwalls, slabs and discharge channel.

(3) Visual observations of the outlet works valve house and catwalk.

(4) Visual observations of the pond drain outlet and discharge channel.

(5) Visual observations of downstream conditions and evaluation of the downstream hazard potential.

(6) Visual observations of the reservoir shoreline and inlet stream channel.

(7) Transit stadia survey of relative elevations along the embankment crest centerline, spillway, and across the embankment slopes.

(8) A geological reconnaissance of the site.

The visual observations were made during periods when the reservoir and tailwater were at normal operating levels.

The visual observations checklist, field plan, and profile, containing the observations and comments of the field inspection team are contained in Appendix A.

Specific observations are illustrated on photographs in Appendix C. Detailed findings of the visual inspection are presented in the following sections.

b. Embankment:

(1) Crest: The embankment crest was observed to be generally straight and level except for a small rise immediately adjacent to the spillway's right training wall. Some erosion had occurred at the right end where natural surface drainage crossed the crest and was was flowing down the embankment's downstream slope. There was evidence of flow across the upstream slope from the same source. The surface drainage was being directed to the crest by a jeep trail on the right abutment slope above the dam.

The crest had considerable barren area and some minor erosion was visible. Possible severe erosion was indicated by the difference in elevation between the crest and spillway training wall. No cracks were observed.

(2) Upstream Slope: The upstream slope was generally grass covered and showed no signs of erosion except for a small gulley immediately adjacent to the spillway's right training wall and near the right groin (junction of embankment and abutment) where jeep trail flows have crossed the slope.

(3) Downstream Slope: The downstream slope was observed to be very flat and mostly barren. Some erosion has occurred near the right groin as a result of drainage from the jeep trail.

No seepage was apparent in the vicinity, but could have been masked by the damp conditions caused by the surface runoff.

The left groin lies along the spillway training wall and showed no sign of erosion or seepage.

No cracks, bulges, non-uniformities, settlement or other signs of slope distress were observed on the downstream slope; no seepage line was observed.

The lower, central portion of the downstream slope contains the access road to the dam crest. The road is barren and had very minor wheel rutting.

c. Abutments:

(1) Right: The right abutment is moderately steep and wooded in the vicinity of the embankment. Two jeep trails approach the crest from above; the upstream trail was providing a channel for the previously discussed surface drainage. No seepage or signs of slope distress were observed.

(1) Left: The left abutment lies beyond the spillway's left training wall and is quite flat. It is at or below the elevation of the embankment crest. Flow from the reservoir around the dam across the abutment is prevented by the left spillway wingwall. A low spot was observed at the upper end of the wingwall but survey data indicated it was 0.4 feet higher than the measured low point on the embankment crest. A natural drainage course for surface runoff was observed on the left abutment, about 50 feet beyond the spillway training wall.

d. Pond Drain:

(1) Conduit Channel: The pond drain discharge conduit is a 24 inch diameter CMP.

(2) Intake Structure: The pond drain inlet is at the valve house which has sluice gate flow controls.

(3) Outlet Structure: The discharge conduit outlet structure is a concrete head wall at the upper end of the pond drain outlet channel. No deterioration of the pipe or head wall was observed.

(4) Outlet Channel: The outlet channel appeared to be excavated into natural ground below the toe of the embankment. The channel was rock lined and had relatively steep side slopes - 1H:1V to 3H:2V. Small trees, some down timber and debris were noted in the channel. Approximately 100 feet below the pond drain outlet, several large rocks blocked the channel but did not appear to significantly affect channel discharge conditions.

On 3 April 1980 considerable seepage was observed in the channel. A significant portion of the seepage was occurring along the channel's right bank near the base of the slope. This seepage showed some minor iron staining at the outlet point. The origin of this water is questionable, as observations

on 27 November 1979 did not reveal seepage conditions of this magnitude. Based on surface runoff and site wetness conditions it is possible that this is natural ground water. A small flow was observed alongside the pond drain concrete headwall and some seepage was noted in the channel bottom immediately below the pond drain outlet. An approximate estimate of seepage discharge in the outlet channel was 10 to 15 gallons per minute on 3 April 1980.

Two sink holes were observed in a terrace immediately above and just to the right of the pond drain outlet channel. The sink holes were located approximately 20 feet and 50 feet below the pond drain outlet. Also, the previously mentioned jeep trail drainage entered the pond drain outlet channel approximately 5 feet below the pond drain outlet.

A gate valve control box was observed at the upstream edge of the crest near the catwalk to the valve house. The Kennametal representative advised that the gate valve was for the pond drain conduit.

e. Water Supply Facility:

(1) Conduit: The 8 inch diameter water supply pipeline was not observed.

(2) Intake Structure: The pipeline intake is at the valve house and is controlled by a gate valve.

f. Principal (Ungated) Spillway:

(1) Approach Channel: The approach channel to the spillway weir crest is contained between two concrete wingwalls that become training walls as they approach the embankment.

No obstructions or conditions were observed in the approach channel that would adversely affect spillway discharge capacity.

Two closed cracks were observed in the concrete walls and no spalling or deterioration was noted.

(2) Weir: The hydraulic flow control for the principal spillway is a concrete weir, 1.8 feet high, one foot wide, and forty feet long. The weir is located along the embankment crest centerline and lies between two concrete training walls. The weir maintains the reservoir pool level and controls both normal and storm outflows.

No cracks, spalling or deterioration were observed in the weir or adjacent training walls and flow over the weir was of uniform depth, indicating a level surface.

(3) Discharge Channel: The principal spillway discharge channel consists of an open channel chute having concrete training walls and a formed concrete base slab.

The chute turns slightly to the right below the weir and had a measured slope of 0.18 feet/foot (18%).

No cracks, spalling or deterioration of the concrete chute was observed.

(4) Bridge: A wooden plank bridge, supported by two roof joists, spans the spillway about four feet below the weir crest. The span was supported by plates on the spillway training walls. The left support had been broken from its anchorage and the bridge structure was displaced downstream. The bridge, through tilted and skewed slightly, appeared to be stable and did not present any apparent obstruction to spillway channel flows.

g. Instrumentation: No formal instrumentation was observed during the inspection.

h. Downstream Conditions:

(1) Embankment Toe Area: The embankment toe area consists of the embankment crest access road and the pond drain discharge channel which have been discussed in Sections 3.1.b(3) and 3.1.d(4), respectively.

(2) Downstream Channel: The downstream channel consists of a 200 foot reach of unformed concrete slab beginning immediately below the discharge channel. Below this is original mountain stream channel.

The unformed slab was approximately 40 feet wide and terminated at a three foot high waterfall where the channel below had been eroded. The slab was observed to have numerous cracks and holes. "Squirting" water was observed at several locations indicating pressure from beneath the slab. The pressure head for the "squirts", however, was very small.

The side slopes along the slab were very gentle and were observed to be tree and brush lined. No flow obstructions were observed.

Below the slab, flow returns to the original mountain creek channel which was observed to be generally winding, with considerable rock and tree debris. The channel passes through a relatively narrow, heavily wooded, uninhabited valley for 5500 feet before reaching inhabited dwellings.

(3) Flood Plain Development: At least 35 inhabited dwellings lie on the Miller Run flood plain in the first three miles below the dam. At approximately three miles below the dam, the Run passes an industrial plant site and the westbound lanes of U. S. Route 30 and empties into Loyalhanna Creek.

h. Reservoir:

(1) Slopes: The reservoir slopes above the shoreline are quite steep, but no fallen trees or slope distress was observed.

(2) Inlet Stream: The inlet stream to the reservoir is a typical mountain brook with winding, rock and tree lined channel.

(3) Sedimentation: No significant sedimentation was observed at the inlet end of the reservoir.

(4) Watershed: The watershed of Kennametal Reservoir Dam lies on the west slope of Chestnut Ridge. According to Kennametal representative, the watershed is owned by Kennametal and is undeveloped except for two lakes. No information on these lakes was available. A cursory visual observation of the nearest of the two, indicated an earthfill dam, approximately 15 feet high and 800 feet long with a small, open channel spillway on the right abutment.

3.2 EVALUATION

a. Embankment: The embankment is considered to be in good condition. Minor deficiencies include erosional distress that is the result of a lack of vegetal cover and surface drainage from the right abutment (jeep trail) that is causing minor erosion of both of the upstream and downstream slopes.

b. Pond Drain:

(1) Operability: The operability of the pond drain flow controls could not be evaluated because the valve house door was locked and no key was available.

(2) Outlet Channel: The seepage observed near the outlet of the pond drain and along the pond drain discharge channel is considered to be a deficiency. Also, the sinkholes observed on the terrace above the pond drain channel are considered to be a problem.

c. Water Supply Facility: The operability of the reported flow control on the upstream end of the water supply pipeline was not evaluated because the valve house door was locked.

d. Principal (Ungated) Spillway: The principal spillway is considered to be in very good condition. Concrete members were not deteriorated and the structure appeared to be capable of full design performance.

The bridge across the spillway was observed to be damaged but appeared safe for foot traffic and did not present a potential obstruction to spillway channel flows.

e. Instrumentation: The principal spillway weir crest provides a flow control that could be utilized to evaluate reservoir discharge conditions.

f. Downstream Conditions:

(1) Downstream Channel: Water flowing beneath the unformed concrete slab is considered to be a problem. Continued underflow could lead to significant erosion of the slab's foundation and resultant destruction of the slab.

(2) Hazard Classification: Based on visual observations of flood plain conditions below the dam, the hazard classification is determined to be "high" since loss of life may occur as a result of failure of the dam.

g. Reservoir: The existence of two impoundments in the watershed above the Kennametal Reservoir dam may affect estimates of watershed hydrologic performance.

SECTION 4
OPERATIONAL FEATURES

4.1 PROCEDURE

Reservoir pool level is maintained by the uncontrolled weir crest of the principal spillway.

The pond drain has two upstream flow controls, a gate valve in the embankment and the intake structure port gates. The pond drain does not normally discharge and it is not normally under pressure through the embankment.

The water supply pipeline has a flow control at the upstream end which is normally open. The pipeline is normally under pressure through the embankment.

Normal operating procedure does not require a dam tender.

4.2 MAINTENANCE OF DAM AND OPERATING FACILITIES

The embankment and appurtenances are maintained by Kennametal, Inc. of Latrobe, Pennsylvania

4.3 INSPECTION OF DAM

Kennametal, Inc. is required by the State of Pennsylvania to inspect the dam annually and make needed repairs.

4.4 WARNING SYSTEM

There are no warning systems or formal emergency procedures to alert or evacuate downstream residents upon threat of a dam failure.

4.5 EVALUATION

There are no written operation, maintenance or inspection procedures, nor is there a warning system or formal emergency procedure for this dam. These procedures should be developed in the form of checklists and step by step instructions, and should be implemented as necessary.

SECTION 5
HYDROLOGY AND HYDRAULICS

5.1 EVALUATION OF FEATURES

a. Design Data: The Kennametal Reservoir Dam has a watershed of 768 acres which is vegetated primarily by woodland and pasture. The watershed is about two and one half miles long, one half mile wide and has a maximum elevation of 3,180 feet above Mean Sea Level (MSL). In the upper watershed are two additional impoundments on Miller Run. Their storage capacity and spillway systems may have some influence on the Kennametal Reservoir Dam. However, due to the lack of design information, their effect was not taken into consideration in our analysis.

At normal pool, the dam impounds a reservoir with a surface area of about 1 acre and a storage volume of 11 acre-feet. Normal pool level is maintained at Elev. 1496.8 by the spillway weir.

According to PennDER files, the design of the proposed spillway was adequate but no calculations are available to indicate what the state requirements for structures of this size were at the time of design. The Kennametal Reservoir Dam spillway capacity for the observed cross section and existing freeboard condition was computed to be 319 cfs. No additional hydrologic calculations were found relating reservoir/spillway performance to the Probable Maximum Flood or fractions thereof.

b. Experience Data: Continuous records of reservoir level or rainfall amounts are not kept. There is no record or report of the embankment being overtopped.

c. Visual Observations: On the date of the field reconnaissance, possible severe erosion of the crest was indicated by the difference in crest and spillway wall elevations. The spillway, weir and training walls were in good condition.

d. Overtopping Potential: Overtopping potential was investigated through the development of the Probable Maximum Flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway. The Corps of Engineers guidelines recommend 0.5 to 1 times the PMF for "small" size, "high" hazard dams. Based on the observed downstream conditions and small storage capacity of the impoundment, Kennametal Reservoir Dam has a Spillway Design Flood (SDF) of one half PMF.

Hydrometeorological Report No. 33 indicates the adjusted 24 hour Probable Maximum Precipitation (PMP) for the subject site is 19.2 inches. No calculations are available to indicate whether the reservoir and spillway are sized to pass a flood corresponding to 9.6 inches of rainfall in 24 hours (1/2 PMP). Consequently, an evaluation of the reservoir/spillway system was performed to determine whether the spillway capacity is adequate under current Corps of Engineers guidelines.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California. The major methodologies and key input data for this program are discussed briefly in Appendix D.

The peak inflow to Kennametal Reservoir dam for the SDF was determined by HEC-1 to be 1227 cfs.

e. Spillway Adequacy: The capacity of the combined reservoir and spillway system was determined to be 0.13 PMF using HEC-1. An initial pool elevation of 1496.8 was assumed prior to commencement of the storm. According to Corps of Engineers' guidelines, Kennametal Reservoir Dam's spillway is "inadequate."

At 0.50 PMF, the dam is overtopped by 1.46 feet of water for 8 hours and 50 minutes. This overtopping depth and duration condition was judged by the evaluting engineer to be sufficient to cause failure of the embankment. Consequently, a dam breach analysis was performed to determine if the spillway is "seriously inadequate.".

For the dam breach analysis, it was assumed that dam failure would begin when the water level in the reservoir reached Elev. 1499.6 which corresponds to a depth of 1 foot above the crest's observed minimum elevation.

To achieve the assumed overtopping failure condition, a 0.35 PMF was routed through the reservoir/spillway system. Initially, the flood wave was routed downstream without embankment failure conditions considered. Results of the dam breach analysis indicated that downstream flooding and the risk of loss of life would not be significantly increased by the assumed failure of the dam. The stream level 1.5 miles downstream where Miller Run parallels State Route 217 would rise 0.4 feet with an increase in flow of 15 percent.

Therefore the Kennametal Reservoir dam's spillway is rated "inadequate" but not "seriously inadequate."

SECTION 6
STRUCTURAL STABILITY

6.1 AVAILABLE INFORMATION

a. Design and Construction Data: All available design documentation, calculations and other data received from the Pennsylvania Department of Environmental Resources were reviewed.

b. Operating Records: There are no written operating records or procedures for this dam.

c. Post-Construction Changes: Since construction in 1957, there are no reports that modifications affecting structural stability were made to this dam.

6.2 EVALUATION

a. Design Documents: The design documentation was, by itself, considered inadequate to evaluate the structure. There were no structural calculations associated with the stability of the embankment or of the appurtenant structures.

b. Visual Observations:

(1) Embankment: The field inspection disclosed no evidence of slope instability of the embankment. There were no apparent bulges, sloughs or non-uniformities that would suggest either local or general foundation and/or embankment movement. There was no observed seepage on or near the embankment that would suggest high ground water conditions. The embankment slopes were observed to be considerably flatter than design drawings indicated. Based on the observed geometry and seepage conditions, the embankment is presumed to be stable.

(2) Seepage: Seepage observed in the vicinity of the pond drain outlet does not represent an immediate threat to the structural integrity of the dam. It may, however, represent a long-term threat depending on the origin of the flow.

(3) Principal Spillway: The principal spillway weir and walls appeared to have adequate structural stability.

c. Performance: No record was found indicating any problem related to structural stability over the 23 year life of the structure.

d. Seismic Stability: According to the Seismic Risk Map of the United States, Kennametal Reservoir Dam is located in Zone 1 where damage due to earthquakes would most likely be minor.

A dam located in Seismic Zone 1 may be assumed to present no hazard from an earthquake, provided static stability conditions are satisfactory and conventional safety margins exist. No calculations were developed to verify this assessment, however.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS

7.1 ASSESSMENT

a. Evaluation:

(1) Embankment: Kennametal Reservoir Dam's embankment is considered to be in good condition with only minor deficiencies observed during the site inspection. These include a lack of vegetation on the crest and downstream slope, and surface runoff onto the embankment's right end. The embankment crest was also found to be up to 1.4 feet lower than the top of the spillway training walls. This deficiency was particularly significant to the hydrologic calculations performed for Section 5.

(2) Outlet Works: The condition of the two pipelines through the embankment could not be determined and the operability of upstream flow controls was not observed. However, there was no surficial indication that either facility was malfunctioning.

(3) Principal Spillway: The condition of the principal spillway is considered to be poor. This is based on the "inadequate" capacity rating determined using the HEC-1 computer program. The spillway was found to pass only 13 percent of the PMF. The Spillway Design Flood is 0.5 PMF because of the dam size and hazard classification.

A breach analysis indicated that downstream flooding and the risk of loss of life would not be significantly increased by an assumed failure of the dam.

The structural condition of the spillway is considered to be very good, with no significant deficiencies observed.

(4) Downstream Conditions: The seepage observed in the pond drain discharge channel and the two sink holes on the terrace above are considered to be deficiencies. This is based on a lack of information related to the origin and extent of the observed conditions.

Also, the structural condition of the unformed concrete slab below the spillway discharge channel is considered to be a minor deficiency. Cracking of the slab and erosion of the slab foundation can be expected to accelerate concrete deterioration.

b. Adequacy of Information: The information available on design, construction, operation and performance history in combination with visual observations, discussions, and hydrology and hydraulic calculations were sufficient to evaluate the embankment and appurtenant structures in accordance with the Phase I investigation guidelines.

c. Urgency: The recommendations presented in Sections 7.2a and 7.2c should be implemented immediately.

7.2 RECOMMENDATIONS

a. Additional Investigations: Immediately retain a professional engineer knowledgeable in dam design and construction to:

(1) Perform a detailed hydrologic/hydraulic analysis of the reservoir and spillway and make recommendations on increasing the capacity of the system to make it adequate.

(2) Evaluate the operability of the upstream flow controls for the water supply and pond drain pipelines.

(3) Inspect the seeps in the pond drain channel and at the pond drain outlet and inspect the sinkholes on the terrace above the pond drain channel and provide recommendations for monitoring and/or control.

b. Remedial Work: The Phase I investigation of Kennametal Reservoir Dam also disclosed several deficiencies of lower priority which should be corrected during routine maintenance.

(1) Divert surface runoff flows away from the right end of the embankment.

(2) Revegetate the embankment crest and downstream slope.

(3) Develop and implement formal maintenance and inspection procedures.

c. Emergency Operation and Warning Plan: Concurrent with the additional investigations recommended above, the owner should develop an Emergency Operation and Warning Plan including:

(1) Guidelines for evaluating inflow during periods of heavy precipitation or runoff.

(2) Procedures for around the clock surveillance during periods of heavy precipitation or runoff.

(3) Procedures for drawdown of the reservoir under emergency conditions.

(4) Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL OBSERVATIONS CHECKLIST I
NON-MASONRY IMPOUNDING STRUCTURE

Name Dam Kennametal County Westmoreland State Pennsylvania National ID # PA 00482

Type of Dam Clay with reinforced concrete core wall Hazard Category High

Date (s) Inspection 27 Nov. 1979 Weather Cold and sunny Temperature 40°F
3 April 1980 Weather Partly cloudy, mild Temperature 55°F

Pool Elevation at Time of Inspection 1497+*

Inspection Personnel: 27 Nov. 1979
J. P. Hannan, Ackenheil & Associates, Geotechnical Engineer
S. G. Mazzella, Ackenheil & Associates, Civil Engineer
J. B. Zeppieri, Ackenheil & Associates, Geologist
H. Findish, Kennametal, Inc., Owner's Representative

Inspection Personnel: 3 April 1980
J. E. Barrick, P.E., & Hydrologist Ackenheil & Associates, Project Manager
S. G. Mazzella, Ackenheil & Associates, Civil Engineer
H. Findish, Kennametal, Inc., Owner's Representative

Recorder (s) J. P. Hannan, 27 Nov. 1979
J. E. Barrick, 3 April 1980

GEO Project G79153-R
PennDER I.D. No. 65-120

*Top of spillway wall assumed to be Elev. 1500 (MSL)

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed except for small erosion channels on the downstream slope.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	The embankment crest and downstream slope contain barren spots which have suffered minor amounts of erosion, particularly at the center of the embankment where access to the embankment crest is gained by vehicle and pedestrian traffic. The crest is also barren particularly in the central portion of the embankment. The right abutment has two jeep trails which are both barren and suffering from some erosion. A certain amount of sedimentation of sand and fine gravel has occurred on the crest below the two jeep trails. Natural runoff is flowing down the upstream jeep trail, across the embankment crest and down the downstream slope. This flow, though not of great magnitude, has caused some erosion of the right end of the embankment crest and downstream slope. The embankment upstream slope has good vegetal cover, mostly grass, very small brush, no significant erosion exists on the upstream slope. The left abutment consists of the concrete spillways' left training wall. Beyond the wall, the ground elevation is at or below the elevation of the embankment crest and some	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES (continued)	erosion and water damage has occurred from natural runoff above the dam. This condition does not effect the performance of either the embankment or spillway. The spillway training wall extends upstream, into the natural reservoir slope.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The crest is approximately level and appears to be straight throughout its length. The crest rises slightly as it approaches the right training wall of the concrete spillway.	
RIPRAP FAILURES	No riprap observed.	
SETTLEMENT	Embankment crest surface is slightly uneven. No evidence of settlement was observed, however.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Right groin is wet, marked with vehicle tracks and partially eroded due to runoff from water flowing down the previously described jeep trail. No seeping water observed in the right groin. The left groin at the right spillway training wall has suffered slight erosion on the upstream slope. No erosion or seepage is evident along the training wall on the downstream slope. A low point appears to exist at the end of the left spillway training wall at the point where it enters the reservoir slope.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	No seepage was observed anywhere on the embankment or immediately adjacent to the embankment. See "Outlet Channel" outlet works (pond drain) below.	
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed.	

OUTLET WORKS
(POND DRAIN)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Pond drain discharge conduit is 24 inch diameter CMP.	
INTAKE STRUCTURE	The pond drain intake is reported to have a sluice gate control at the inlet end, as well as a gate valve in the embankment.	
OUTLET STRUCTURE	Pond drain outlet structure consists of a concrete head wall and 24 inch diameter CMP. Discharge is directly to the outlet channel.	
OUTLET CHANNEL	The outlet channel appears to be excavated into natural ground below the toe of the embankment. The channel is rock lined and has relatively steep slopes-1H:1V to 3H:2V. Small trees, some down timber and debris exist in the channel. Approximately 100 feet below the pond drain outlet, several large rocks have been placed into the pond drain channel. They do not appear to affect pond drain channel discharge conditions. Considerable seepage is exiting the walls of the pond drain outlet channel. As far downstream as 75 feet, significant seeps exist at the base of the channel. A small flow was observed alongside the pond drain concrete headwall. Some seepage was noted in the area of the channel bottom immediately below the pond drain outlet.	

OUTLET WORKS
(POND DRAIN)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
OUTLET CHANNEL (continued)	A significant portion of the seepage flowing in the pond drain outlet channel is occurring along the pond drain channel's right bank near the base of the channel. This seepage, which begins approximately 50 feet below the pond drain outlet shows some minor iron staining at the outlet point. The origin of this water is questionable. Based on surface runoff and wetness conditions it is possible that this water is natural groundwater. Observations on 27 November 1979 did not reveal seepage conditions of this magnitude. An approximate estimate of seepage discharge in the outlet channel is 10 to 15 gallons per minute. Two sinkholes were observed in a terrace immediately above and just to the right of the pond drain outlet channel. The sinkholes are located approximately 20 feet and 50 feet below the pond drain outlet. Also the previously mentioned drainage across the right groin enters the pond drain outlet channel approximately 5 feet below the pond drain outlet. Some sedimentation has occurred here, probably from silts carried from the area above the dam.	
EMERGENCY GATE	The pond drain outlet control valve box was observed at the upstream edge of the crest near the walkway to the water supply facility intake house.	

OUTLET WORKS
(WATER SUPPLY PIPE)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
TYPE	8 inch diameter transite	
INTAKE STRUCTURE	Intake via screen inlet in valve hose. Gate valve at upstream end of pipe according to Mr. Findish.	

PRINCIPAL (UNGATED) SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The concrete weir is 40 feet long, has a crest width of 1 foot, is 1.8 feet high and is observed to have water flowing uniformly over its length. Condition of weir is excellent-no cracks, no spalling, no distress at construction joints.	
APPROACH CHANNEL	The approach channel is contained between two reinforced concrete wingwalls. The approach channel is clear providing unobstructed access to the spillway. The wingwalls appear to be in good condition, two minor cracks were observed, no significant spalling, no distress at construction joints.	
DISCHARGE CHANNEL	The discharge channel consists of a concrete slab extension to the concrete weir and is contained between two reinforced concrete training wall extensions of the upstream approach channel wingwalls. The condition of the slab is excellent with water flowing uniformly over its length. The condition of the training walls is good, with only minor cracks observed, no significant spalling, no distress of construction joints. The slope of the discharge channel was measured to be 0.18 feet/foot (18%).	
BRIDGE AND PIERS	A wooden plank bridge on joists spans the principal spillway between the training walls approximately 4 feet below the spillway weir crest. The bridge rests on steel plates contacting the training wall. At the left end, the plates	

PRINCIPAL (UNGATED) SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
BRIDGE AND PIERS (continued)	have broken from their anchorage and the bridge has been displaced approximately 2 feet downstream. The bridge appears to stable and does not present any obstruction to channel flows.	
GATES AND OPERATION EQUIPMENT	None observed.	

DOWNSTREAM CHANNEL

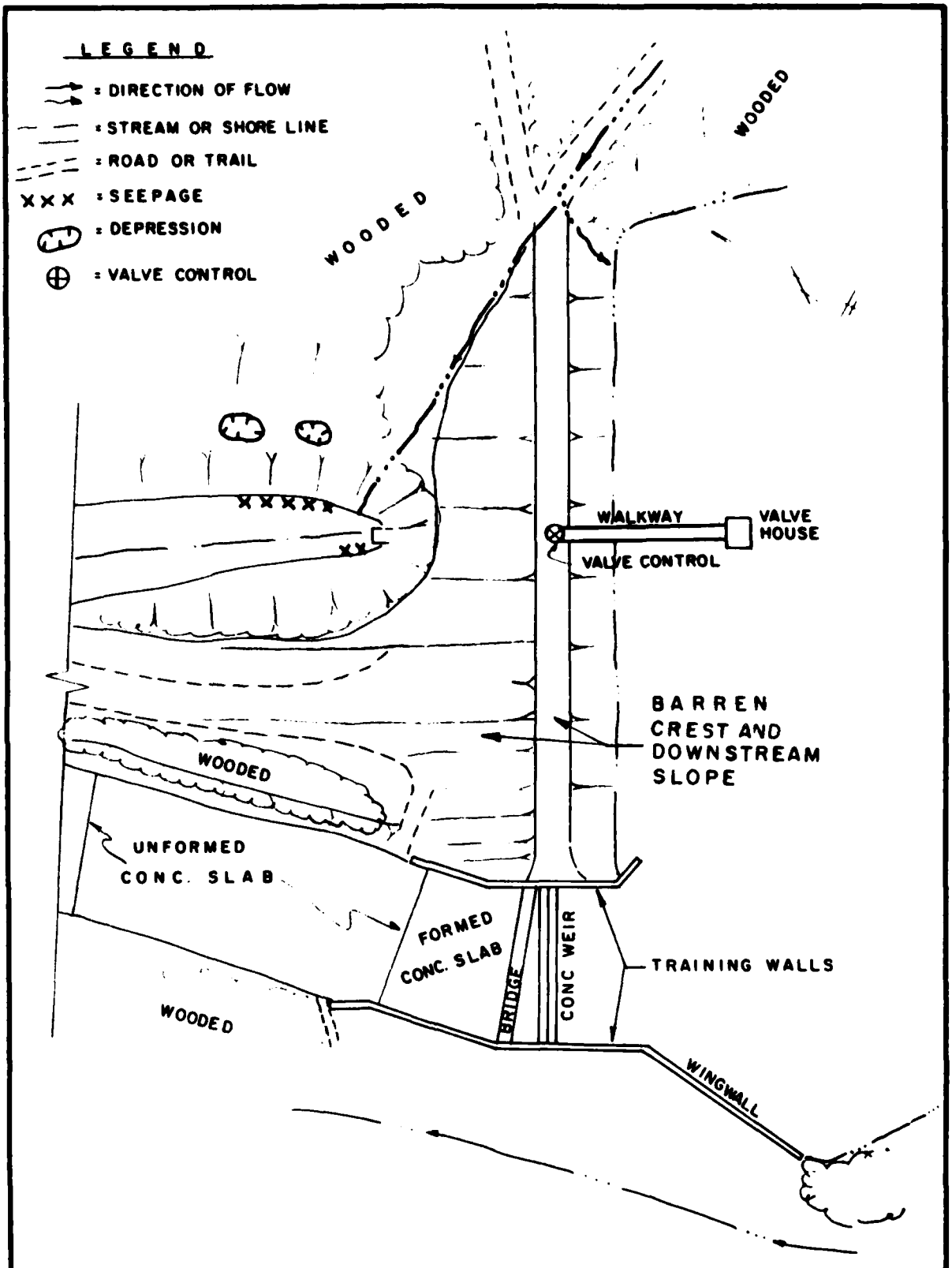
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel immediately below the spillway discharge channel consists of a rough poured concrete slab approximately 200 feet long. The concrete shows numerous cracks and holes. Some of the holes are "squirting", indicating flow under pressure. Approximately 100 feet below the weir, a large sinkhole has developed which is approximately 1 foot deep and 5 feet across. Approximately 250 feet below the concrete weir crest, the concrete channel terminates at an overfall, where an additional section of the rough poured concrete has broken off. The waterfall is approximately 3 feet high. Below this, discharge is to the natural rock lined mountain stream channel which is winding and tree, debris and rock littered.	
SLOPES	The downstream channel slopes in the reach where the rough poured slab exists are very gentle. They are tree lined and rock covered generally providing significant erosion resistance. The slopes steepen below, along the natural stream channel.	
APPROXIMATE NO. OF HOMES AND POPULATION	Numerous inhabited dwelling lie on the flood plain beginning 5500 feet below the dam.	

INSTRUMENTATION

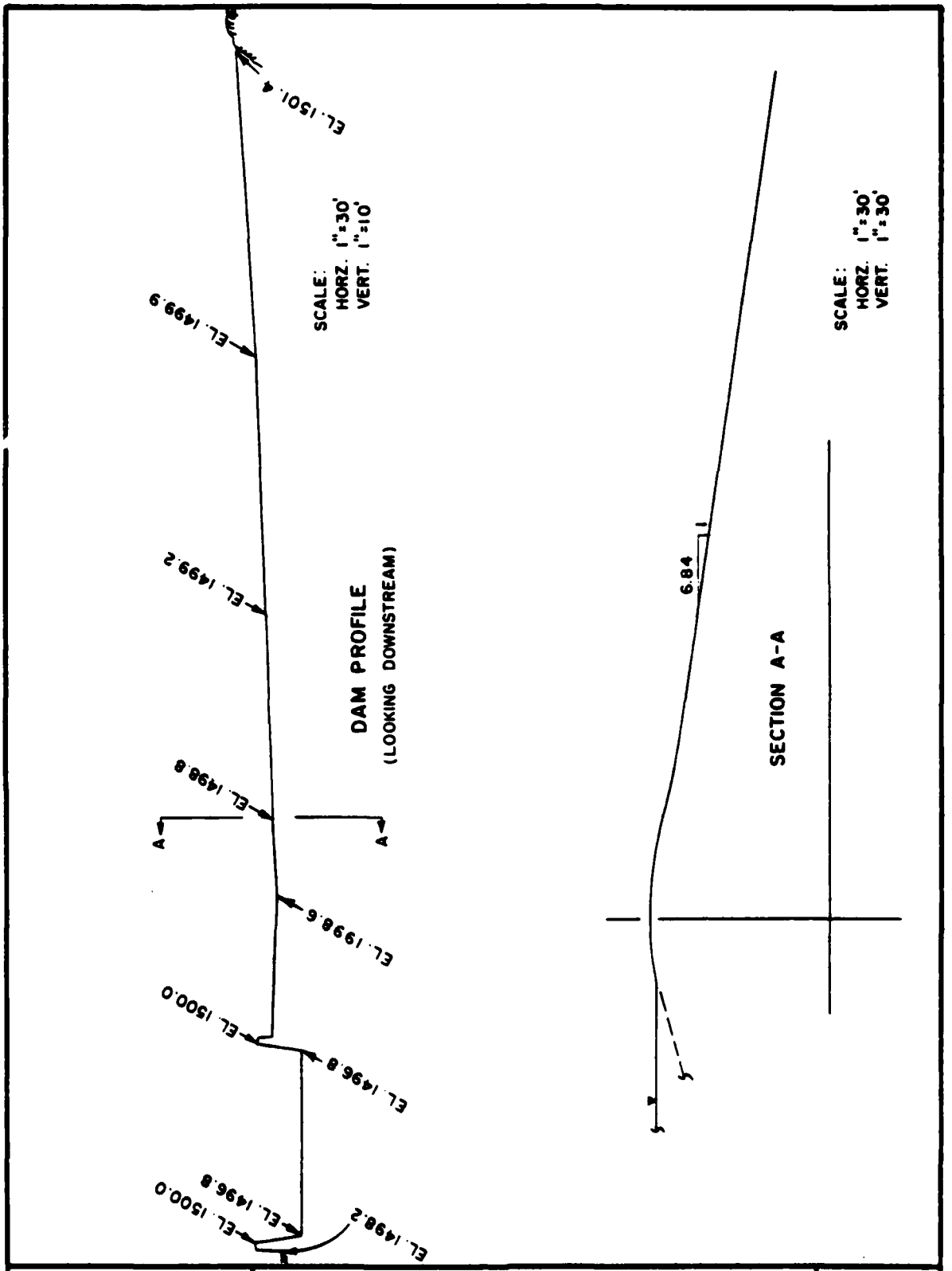
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed. Top of spillway wall assumed to be Elev. 1500 MSL.	
OBSERVATION WELLS	None observed. Foundation grout pipes observed along dam crest but no measurements attempted.	
WEIRS	See: Principal (Ungated) Spillway - Concrete Weir	
PIEZOMETERS	None oserved.	
OTHER	Capacity measuring device not in order.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Reservoir slopes, both right and left, are quite steep and wooded with small to medium sized trees. The right reservoir slope is quite rocky, appearing to be the outcrop of a sandstone layer. No instability of reservoir slopes observed. No fallen trees, down timber or brush observed along the reservoir shoreline.	
INLET STREAM	The inlet stream to Kennametal Reservoir is a typical mountain brook. It has a winding channel, very rocky, closely lined with trees and brush. The clarity of the water is excellent.	
SEDIMENTATION	No significant sedimentation observed at the inlet end of the reservoir.	
WATERSHED	The watershed of Kennametal Reservoir lies on the west slope of Chestnut Ridge. According to Mr. Findish, the watershed is owned by Kennametal and is entirely wooded. U.S.G.S. topographic map indicates two reservoirs upstream of the Kennametal Reservoir. No information was available on either reservoir. According to Mr. Findish, the watershed is otherwise entirely undeveloped. A cursory observation of the nearest upstream dam indicated construction of earth, approximately 15 feet high and 800 feet long, and a small open channel spillway in the right abutment.	



DATE: MAY 1980	KENNAMETAL RESERVOIR DAM NATIONAL DAM INSPECTION PROGRAM		FIELD PLAN
SCALE: NONE			
DR: PT	CK: JEB	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	



DATE: MAY 1980	KENNAMETAL RESERVOIR DAM NATIONAL DAM INSPECTION PROGRAM	FIELD PROFILE AND SECTION
SCALE: AS SHOWN		
DR: JF CK: JEB	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	

APPENDIX B

ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Kennametal Reservoir
I.D. No. PA 00482

ITEM	REMARKS
*Design Drawings	"Plan and Cross Sections, Proposed Miller Run Reservoir, Derry Township, Westmoreland County, Pennsylvania for Kenna Metals, Inc., Latrobe, PA" dated April 1957. "Longitudinal Section Proposed Miller Run Reservoir, Derry Township, Westmoreland County, Pennsylvania for Kenna Metals, Inc." dated June 1957.
As-Built Drawings	None available.
Regional Vicinity Map	U.S.G.S. 7.5 Minute Derry, Pennsylvania quadrangle map showing dam site location. See Appendix E.
Construction History	Designed by Walter S. Thomas and constructed in 1957 by Dill Construction Company of Latrobe, Pennsylvania.
*Typical Sections of Dam	See "Longitudinal Section, Proposed Miller Run Reservoir" in Appendix E.

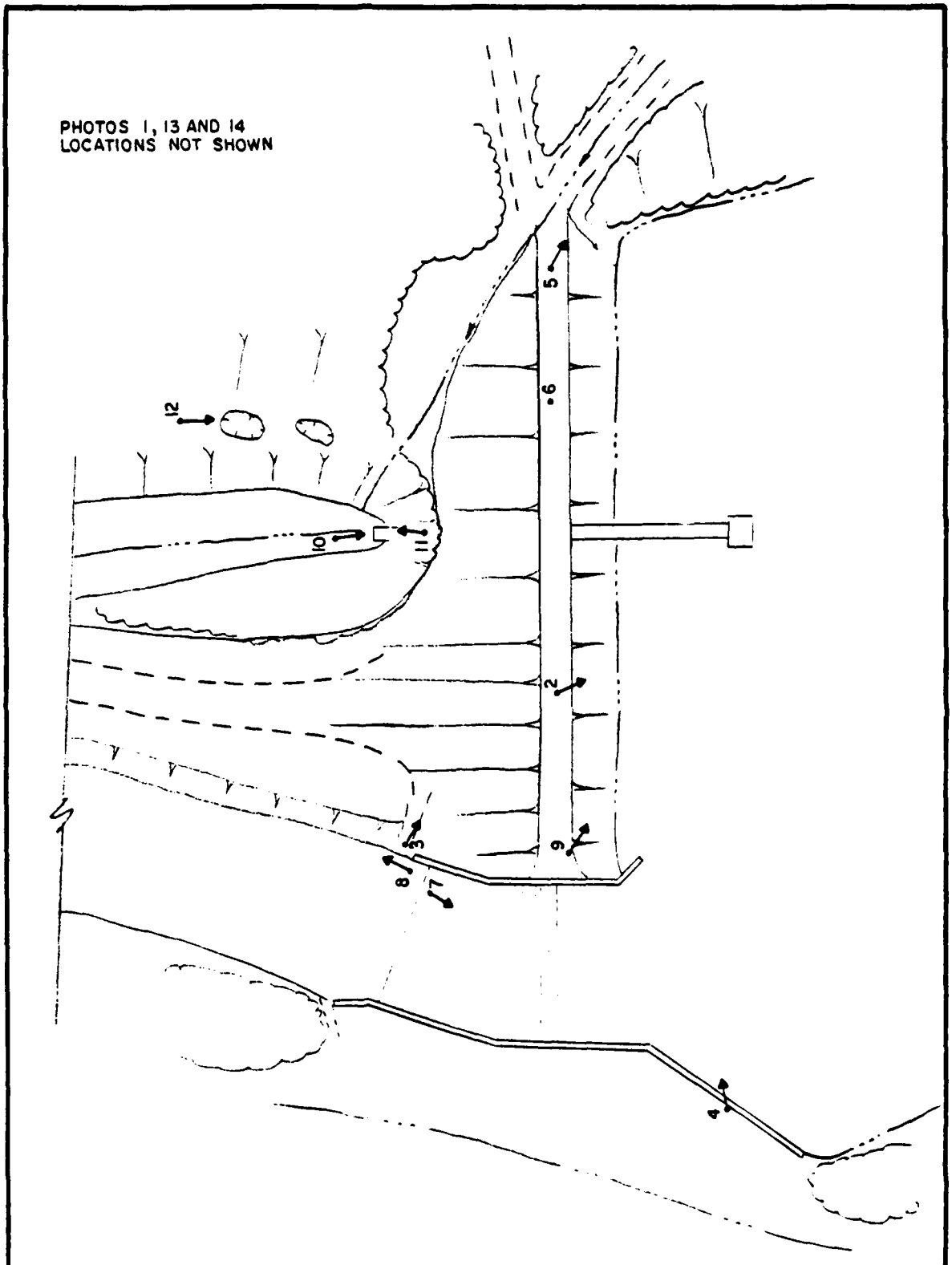
ITEM	REMARKS
*Outlets - Plans Details Constraints	See "Longitudinal Section, Proposed Miller Run Reservoir" in Appendix E.
Rainfall/Reservoir Records	None recorded.
*Design Report	See "Report Upon the Application of Kennametal, Inc." dated Harrisburg, 4 April 1957.
Geology Report	None available. See Appendix F.
Design Computations Dam Stability Seepage Studies	None available.
Materials Investigations Boring Records Laboratory Field	None available.
Post-Construction Surveys of Dam	None reported.
Borrow Sources	No information available.

ITEM	REMARKS
Monitoring Systems	None reported.
Modifications	None reported.
High Pool Records	None reported.
Maintenance Operation Records	None reported.
*Spillway - Plan Section Details	See "Longitudinal Section, Proposed Miller Run Reservoir" in Appendix E.
Operating Equipment Plans and Details	See Design Drawing above.
Specifications	None available.
*Miscellaneous	One inspection report by state officials on 23 April 1964. Miscellaneous correspondence.
Prior Accidents or Failure of Dam Description Reports	None reported.

*Information and data may be obtained from the Pennsylvania Department of Environmental Resources, Harrisburg, Pennsylvania.

APPENDIX C

PHOTOGRAPHS



DATE: MAY 1980	KENNAMETAL RESERVOIR DAM NATIONAL DAM INSPECTION PROGRAM		PHOTO KEY MAP
SCALE: NONE			
DR: PT	CK: JEB	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	

PR

KENNAMETAL RESERVOIR DAM

PHOTO 1. EMBANKMENT CREST AND SPILLWAY

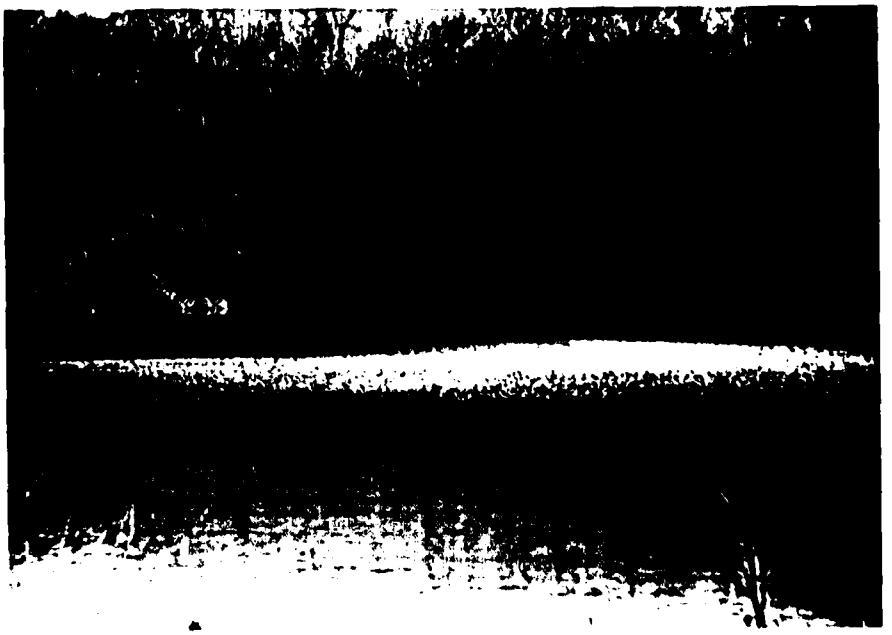


PHOTO 2. RESERVOIR AND INLET STREAM

KENNAMETAL RESERVOIR DAM

PHOTO 3 DOWNSTREAM EMBANKMENT SLOPE

PHOTO 4 EMBANKMENT CREST AND RIGHT ABUTMENT

PHOTO 5. RIGHT ABUTMENT AREA

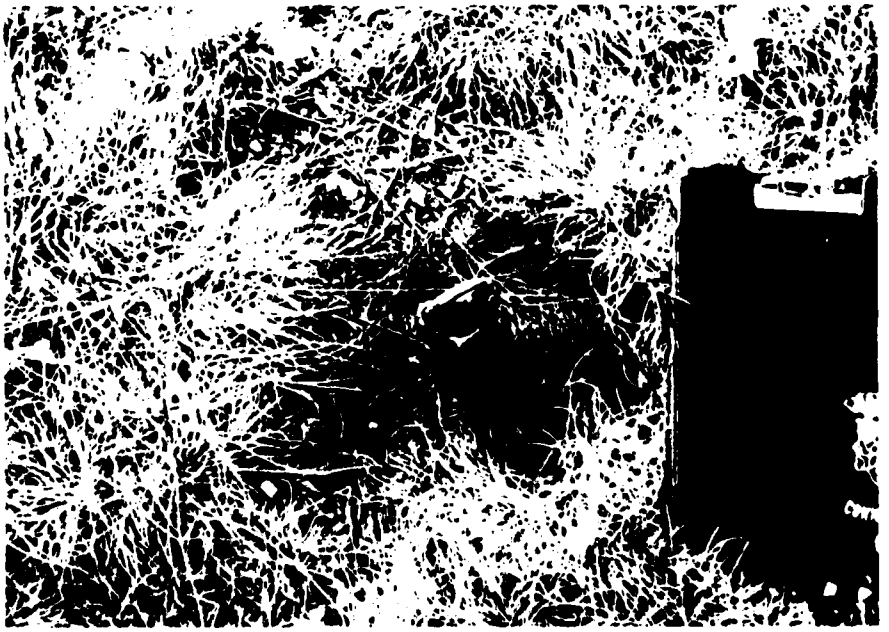


PHOTO 6. GROUT PIPE

KENNAMETAL RESERVOIR DAM

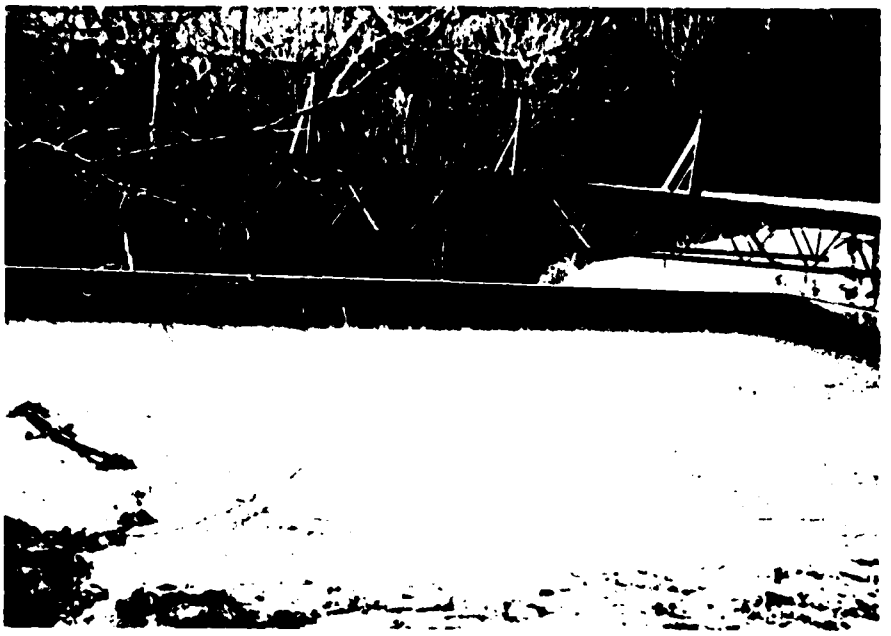


PHOTO 7. PRINCIPAL SPILLWAY WEIR

PHOTO 8. DOWNSTREAM CHANNEL

KENNAMETAL RESERVOIR DAM

PHOTO 9. VALVE HOUSE AND WALKWAY

PHOTO 10. POND DRAIN OUTLET

PHOTO 11. POND DRAIN DISCHARGE CHANNEL

PHOTO 12. SINKHOLE

PHOTO 13. DOWNSTREAM DEVELOPMENT

PHOTO 14. MILLER RUN

DETAILED PHOTO DESCRIPTIONS

Photo 1 Embankment Crest and Spillway from upstream. Note spillway bridge and valve house.

Photo 2 Reservoir and Inlet Stream from embankment crest. Note steep shoreline conditions.

Photo 3 Downstream Embankment Slope taken from downstream spillway channel. Note lack of vegetation on slope and vehicle trail on right abutment.

Photo 4 Embankment Crest and Right Abutment taken from left abutment.

Photo 5 Right Abutment Area taken from embankment crest. Note surface runoff flowing onto embankment crest from vehicle trail.

Photo 6 Grout Pipe located in the right portion of embankment crest. Red fluid on ground was also found in the pipe.

Photo 7 Principal Spillway Weir looking upstream from the discharge channel. Note skewed bridge. Left support has been broken and is displaced downstream.

Photo 8 Downstream Channel below discharge channel showing unformed concrete slab.

Photo 9 Valve House and Walkway

Photo 10 Pond Drain Outlet

Photo 11 Pond Drain Discharge Channel taken from pond drain outlet.

Photo 12 Sinkhole on terrace above pond drain discharge channel. Sinkhole is located 50 feet downstream of the pond drain outlet and immediately above an area of concentrated seepage in the channel bottom.

Photo 13 Downstream Development. Miller Run is located to the right of the residence.

Photo 14 Miller Run below dam showing inhabited dwellings on floodplain.

APPENDIX D

HYDROLOGY AND HYDRAULICS ANALYSES

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology: The dam overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version), July, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation: The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 33" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph: The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters, their definition and how they were obtained for these analyses.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel	From U.S.G.S. 7.5 minute topographic map
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic map

Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic map

3. Routing: Reservoir routing is accomplished by using Modified Puls routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation-discharge relationship.

Storage in the pool area is defined by an area-elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping: Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach Downstream Routing: The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer with given input assumptions) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre and post failure water depths are calculated at locations where cross-sections are input.

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Predominately wooded, no development noted.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1496.8 (11 acre-feet.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1498.6 (14 acre-feet.)

ELEVATION MAXIMUM DESIGN POOL: 1500.0

ELEVATION TOP DAM: 1498.6 (minimum)

OVERFLOW SECTION

a. Elevation 1496.8
b. Type Concrete weir
c. Width 40 feet
d. Length N/A
e. Location Spillover Left abutment
f. Number and Type of Gates None

OUTLET WORKS

a. Type 8 inch water supply pipe
b. Location Left of centerline, near downstream toe
c. Entrance Inverts 1480 ±
d. Exit Inverts 1465 ±
e. Emergency Drawdown Facilities 24 inch outlet pipe (pond drain) at center of dam

HYDROMETEOROLOGICAL GAGES

a. Type Stage recorder (not working)
b. Location Gate house
c. Records None available

MAXIMUM REPORTED NON-DAMAGING DISCHARGE None recorded

HEC-1 DAM SAFETY VERSION
HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: Kennametal Reservoir Dam	NDI ID NO. PA 482
Probable Maximum Precipitation (PMP)	24.0*
Drainage Area	1.2 sq. mi.
Reduction of PMP Rainfall for Data Fit Reduce by 20%, therefore PMP rainfall =	0.8 (24) =19.2 in.
Adjustments of PMF for Drainage Area (Zone 7)	
6 hrs.	102%
12 hrs.	120%
24 hrs.	130%
Snyder Unit Hydrograph Parameters	
Zone	24**
C_p	0.45
C_t	1.6
L	1.9 mile
L_{ca}	0.95 mile
$t_p = C_t (L \cdot L_{ca})^{0.3}$ =	1.91 hours
Loss Rates	
Initial Loss	1.0 inch
Constant Loss Rate	0.05 inch/hour
Base Flow Generation Parameters	
Flow at Start of Storm	1.5 cfs/sq.mi=1.8 cfs
Base Flow Cutoff	0.05 x Q peak
Recession Ratio	2.0
Overflow Section Data	
Crest Length	40 feet
Freeboard	1.8 feet
Discharge Coefficient	2.69-3.32
Exponent	1.5
Discharge Capacity	319 cfs
Breach Parameters	
Section Slope	0.5:1
Section Height	20 feet
Section Width	180 feet
Duration of Failure	2.0 hour
Depth of Maximum Overtopping Prior to Failure	1.0 foot
PMF Storm	0.35

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* Hydrometerological Report 33

** Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

Sheet _____ of _____

ACKENHEIL & ASSOCIATES
GEO Systems, Inc.
1000 Banksville Road
PITTSBURGH, PA. 15216
(412) 531-7111

Job KENNAMETAL RESERVOIR DAM Job No. 79153R

Subject DATA INPUT

Made By JPH Date 4/26/80 Checked EHB Date 4/29/80

LOSS RATE AND BASE FLOW PARAMETERS

As Recommended by COE of ENGINEERS, BALTIMORE DISTRICT

STRTL = 1 INCH
CNSTL = 0.05 inches/hour
STRTQ = 1.5 cfs/mi²
QRCSN = 0.05 (5% of PEAK FLOW)
RTIOR = 2.0

ELEVATION - AREA - CAPACITY - RELATIONSHIPS

From U.S.G.S. 7.5 min QUAD, PENNDER files AND
Field INSPECTION DATA

At ELEVATION = 1495.0 (ORIGINAL OUTFLOW ELEVATION)

Initial Storage = 9.2 Acre feet

POND SURFACE AREA = 0.9 Acres

AT elevation 1520, Area = 11.0 Acres

AT elevation 1540, AREA = 16.5 Acres

From CONIC Method for Reservoir Volume
Flood hydrograph Package (HEC-1)
Dam Safety Version (Users Manual)

H = 3V/A = 3(9.2)/0.9 = 30.7

Elevation where Area equals zero

1495.0 - 30.7 = 1464.3

AREA	3A	0.0	0.9	11.0	16.5
ELEVATION	$E	1464.3	1495.0	1520.0	1540.0

Sheet _____ of _____

ACKENHEIL & ASSOCIATES
GEO Systems, Inc.
1000 Banksville Road
PITTSBURGH, PA 15216
(412) 531-7111

Job KRYNAMETAL Raystown Dam Job No. 79153R

Subject SPILLWAY RATING CURVE

Made By JDH Date 4/24/89 Checked EHB Date 4/24/89

$Q = C L H^{3/2}$ $L = 40$

Elevation	Head	"C" *	Q
1496.8	0	2.69	0
1497.0	0.2	2.72	9.7
1497.2	0.4	2.75	29.8
1497.4	0.6	2.85	53.0
1497.6	0.8	2.98	85.3
1497.8	1.0	3.08	123.2
1498.0	1.2	3.20	168.3
1498.2	1.4	3.28	217.3
1498.4	1.6	3.31	268.0
1498.6	1.8	3.30	318.7
1498.8	2.0	3.31	374.5
1499.3	2.5	3.32	524.9
1499.8	3.0	3.32	690.0
1500.3	3.5	3.32	869.6
1500.8	4.0	3.32	1062.4
1501.3	4.5	3.32	1267.7
1501.8	5.0	3.32	1484.7
1502.3	5.5	3.32	1712.9

* Values for "C" taken From "King and Brater" Handbook of Hydraulics" Table 5-3, Page 5-46.

ACKENHEIL & ASSOCIATES
GEO Systems, Inc.
1000 Banksville Road
PITTSBURGH, PA. 15216
(412) 531-7111

Sheet _____ of _____

Job KENNAMETAL Reservoir Dam Job No 79153R

Subject DATA INPUT

Made By JDH Date 4/24/80 Checked EHS Date 4/24/80

Overtop Parameters

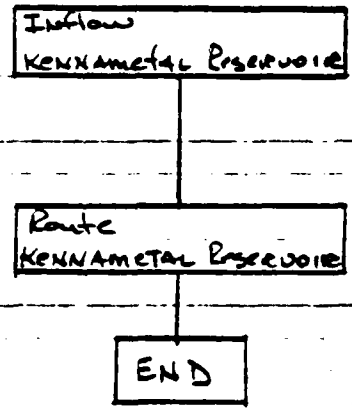
TOP OF DAM ELEVATION (MINIMUM) 1498.6

LENGTH of Dam (excluding spillway) 210 feet

Coefficient of Discharge 3.1

L_{MAX} = 220 V_{MAX} 1510

Program Schedule



Sheet _____ of _____

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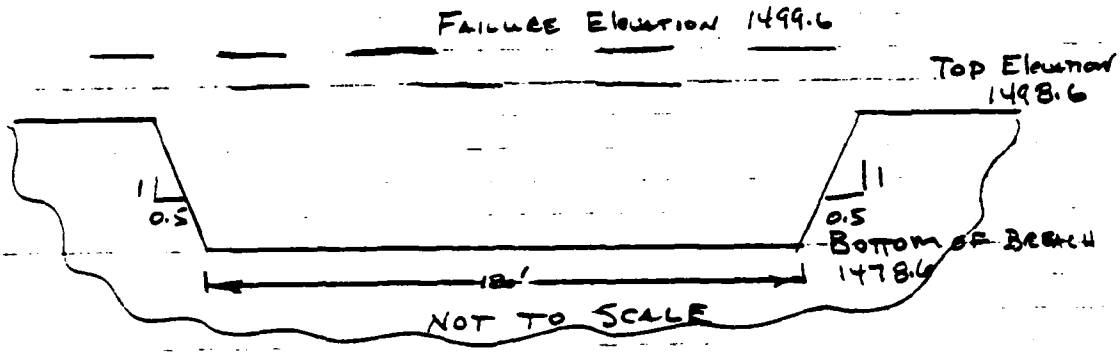
GEO Systems, Inc.
1000 Banksville Road
PITTSBURGH, PA. 15216
(412) 531-7111

Job KENNAMETAL RESERVOIR DAM Job No. 7915 3E
Subject BREACH AND DOWNSTREAM ROUTING PARAMETERS
Made By JDH Date 4/16/80 Checked CHB Date 4/20/80

BREACH PARAMETERS

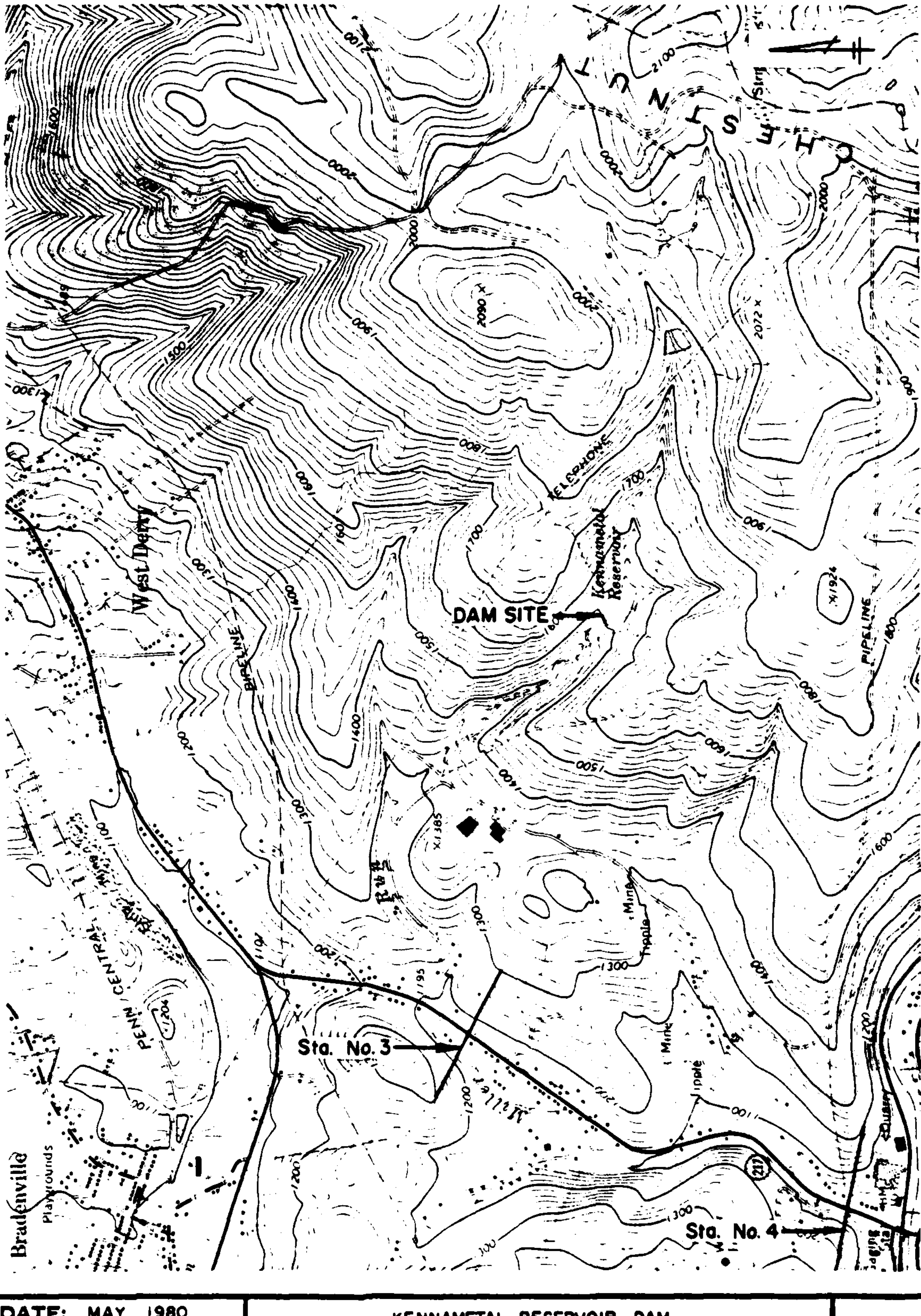


RATIO OF DMF (RTIO) = 0.35
SIDE SLOPE of BREACH (Z) = 0.5
FAILURE TIME (TFAIL) = 2 hours
BREACH WIDTH (BEWID) = 180 Feet

CHANNEL ROUTING

CHANNEL CROSS-SECTIONS OBTAINED FROM U.S.G.S. 7½' QUAD

CHANNEL MANNINGS "N" QN(2) = 0.03
OVERBANK MANNINGS "N" QN(1) = 0.07



DATE: MAY 1980		KENNAMETAL RESERVOIR DAM	DAMAGE STATION MAP
SCALE: 1" = 2000'		NATIONAL DAM INSPECTION PROGRAM	
DR:	CK:	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	

10 7100 ALBANENE A. & B. SMITH CO., PGH., PA.

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1              A1       NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
    2              A2       HYDROLOGIC AND HYDRAULIC ANALYSIS OF KENNAMETAL RESERVOIR DAM
    3              A3       PROBABLE MAXIMUM FLOOD PMF/UNIT GRAPH BY SNYDERS METHOD
    4              B    300      0       5       0       0       0       0       0      -4       0
    5              B1     5
    6              J      1       5       1
    7              J1    1.      .8      .5      .3      .2
    8              K      0       1                                       1
    9              K1       INFLOW HYDROGRAPH FOR KENNAMETAL RESERVOIR DAM
   10              M      1       1     1.2               1.2                                     1
   11              P              24     102     120     130
   12              T                                                    1.0     .05
   13              W   1.91    0.45
   14              X   -1.5   -0.05     2.0
   15              K      1       2                                       1
   16              K1       ROUTING AT KENNAMETAL RESERVOIR DAM
   17              Y                                       1               1
   18              Y1     1                                                9.21      -1
   19              Y4 1496.8  1497.0  1497.2  1497.4  1497.6  1497.8  1498.0  1498.2  1498.4  1498.6
   20              Y4 1498.8  1499.3  1499.8  1500.3  1500.8  1501.3  1501.8  1502.3
   21              Y5    0.0     9.7    27.8    53.0    85.3   123.2   168.3   217.3   268.0   318.7
   22              Y5  374.5   524.9   690.0   869.6  1062.4  1267.7  1484.7  1712.9
   23              $A    0.0     0.9    11.0    16.5
   24              $E 1464.3  1495.0  1520.0  1540.0
   25              $$ 1496.8
   26              $D 1498.6     3.1     1.5   210.
   27              $L    40.     60.    160.    220.    230.
   28              $V 1498.6  1499.   1500.   1501.4  1510.
   29              K      99
   30              A
   31              A
   32              A
   33              A
   34              A
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1
ROUTE HYDROGRAPH TO 2
END OF NETWORK

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
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RUN DATE: 28 APR 80
RUN TIME: 8. 2.34

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
HYDROLOGIC AND HYDRAULIC ANALYSIS OF KENNAMETAL RESERVOIR DAM
PROBABLE MAXIMUM FLOOD PMF/UNIT GRAPH BY SNYDERS METHOD

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	5	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1
RTIOS= 1.00 0.80 0.50 0.30 0.20

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH FOR KENNAMETAL RESERVOIR DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.20	0.0	1.20	0.0	0.0	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	24.00	102.00	120.00	130.00	0.0	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA

TP= 1.91 CP=0.45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 1.91 HOURS, CP= 0.45 VOL= 0.91

2.	6.	12.	20.	29.	38.	49.	60.	71.	83.
96.	108.	121.	133.	144.	153.	162.	170.	176.	181.
185.	187.	188.	186.	181.	177.	172.	167.	163.	158.
154.	150.	146.	142.	138.	134.	131.	127.	124.	120.
117.	114.	111.	108.	105.	102.	99.	97.	94.	92.
89.	87.	84.	82.	80.	78.	76.	74.	72.	70.
68.	66.	64.	62.	61.	59.	58.	56.	54.	53.
52.	50.	49.	48.	46.	45.	44.	43.	41.	40.
39.	38.	37.	36.	35.	34.	33.	32.	32.	31.
30.	29.	28.	28.	27.	26.	25.	25.	24.	23.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	24.96	23.08	1.88	191668.
										(634.)	(586.)	(48.)	(5427.44)

********** *********** ********** ********* **********

HYDROGRAPH ROUTING

ROUTING AT KENNAMETAL RESERVOIR DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.0	0.0	1	0	1	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	9.	-1

STAGE	1496.80	1497.00	1497.20	1497.40	1497.60	1497.80	1498.00	1498.20	1498.40
	1498.80	1499.30	1499.80	1500.30	1500.80	1501.30	1501.80	1502.30	
FLOW	0.0	9.70	27.80	53.00	85.30	123.20	168.30	217.30	268.00
	374.50	524.90	690.00	869.60	1062.40	1267.70	1484.70	1712.90	

SURFACE AREA=	0.	1.	11.	17.
CAPACITY=	0.	9.	135.	408.
ELEVATION=	1464.	1495.	1520.	1540.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1496.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	DAM DATA			
	TOPEL	COQD	EXPD	DAMWID
	1498.6	3.1	1.5	210.

CREST LENGTH	40.	60.	160.	220.	230.
AT OR BELOW ELEVATION	1498.6	1499.0	1500.0	1501.4	1510.0

PEAK OUTFLOW IS 2453. AT TIME 17.50 HOURS

PEAK OUTFLOW IS 1963. AT TIME 17.50 HOURS

PEAK OUTFLOW IS 1227. AT TIME 17.50 HOURS

PEAK OUTFLOW IS 736. AT TIME 17.50 HOURS

PEAK OUTFLOW IS 490. AT TIME 17.50 HOURS

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

				RATIOS APPLIED TO FLOWS				
OPERATION	STATION	AREA	PLAN	RATIO 1 1.00	RATIO 2 0.80	RATIO 3 0.50	RATIO 4 0.30	RATIO 5 0.20
HYDROGRAPH AT	1	1.20	1	2453.	1963.	1227.	736.	491.
	(	3.11)	(	69.47)(	55.57)(	34.73)(	20.84)(	13.89)(
ROUTED TO	2	1.20	1	2453.	1963.	1227.	736.	490.
	(	3.11)	(	69.46)(	55.57)(	34.73)(	20.83)(	13.88)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1495.00	1496.80	1498.60
STORAGE	9.	11.	14.
OUTFLOW	0.	0.	319.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1501.02	2.42	19.	2453.	11.75	17.50	0.0
0.80	1500.68	2.08	18.	1963.	10.83	17.50	0.0
0.50	1500.06	1.46	16.	1227.	8.83	17.50	0.0
0.30	1499.48	0.88	15.	736.	6.00	17.50	0.0
0.20	1499.04	0.44	15.	490.	3.83	17.50	0.0

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1              A1       NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
    2              A2       HYDROLOGIC AND HYDRAULIC ANALYSIS OF KENNAMETAL RESERVOIR DAM
    3              A3       PROBABLE MAXIMUM FLOOD PMF/UNIT GRAPH BY SNYDERS METHOD
    4              B   300       0       5       0       0       0       0       0      -4       0
    5              B1    5
    6              J     2       1       1
    7              J1 0.35
    8              K     0       1                                               1
    9              K1       INFLOW HYDROGRAPH FOR KENNAMETAL RESERVOIR DAM
   10              M     1       1     1.2               1.2                                     1
   11              P             24     102     120     130
   12              T                                                     1.0     .05
   13              W  1.91    0.45
   14              X  -1.5   -0.05     2.0
   15              K     1       2                                               1
   16              K1       ROUTING AT KENNAMETAL RESERVOIR DAM
   17              Y                                     1       1
   18              Y1    1                                                 9.21      -1
   19              Y4 1496.8  1497.0  1497.2  1497.4  1497.6  1497.8  1498.0  1498.2  1498.4  1498.6
   20              Y4 1498.8  1499.3  1499.8  1500.3  1500.8  1501.3  1501.8  1502.3
   21              Y5   0.0     9.7    27.8    53.0    85.3   123.2   168.3   217.3   268.0   318.7
   22              Y5 374.5   524.9   690.0   869.6  1062.4  1267.7  1484.7  1712.9
   23              SA   0.0     0.9    11.0    16.5
   24              SE 1464.3  1495.0  1520.0  1540.0
   25              SS 1496.3
   26              SD 1498.6     3.1     1.5   210.
   27              SL    40.     60.    160.    220.    230.
   28              SW 1498.6  1499.   1500.   1501.4  1510.
   29              SB   180.     0.5  1478.6     2.0  1496.3   1502.
   30              SB   180.     0.5  1478.6     2.0  1496.8  1499.6
   31              K     1       3                                               1
   32              K1       MOD PULS ROUTING FROM DAM TO STATION THREE
   33              Y                                     1       1
   34              Y1    1
   35              Y6 0.07    0.03    0.07  1165.   1300.   8000.    0.04
   36              Y7   0.0  1300.   1000.   1180.   1300.   1170.   1300.   1165.   1310.   1165.
   37              Y7 1310.   1170.   1400.   1200.   2000.   1300.
   38              K     1       4                                               1
   39              K1       MOD PULS ROUTING FROM STATION THREE TO STATION FOUR
   40              Y                                     1       1
   41              Y1    1
   42              Y6 0.07    0.03    0.07  1030.   1200.   6000.    0.02
   43              Y7   0.0  1200.   1000.   1140.   1100.   1035.   1100.   1030.   1115.   1030.
   44              Y7 1115.   1035.   1200.   1140.   2000.   1200.
   45              K    99
   46              A
   47              A
   48              A
   49              A
   50              A            PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                    RUNOFF HYDROGRAPH AT          1
                                    ROUTE HYDROGRAPH TO           2
                                    ROUTE HYDROGRAPH TO           3
                                    ROUTE HYDROGRAPH TO           4
**********                          END OF NETWORK
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE: 12 MAY 80
RUN  TIME: 14.19.48

                    NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
                    HYDROLOGIC AND HYDRAULIC ANALYSIS OF KENNAMETAL RESERVOIR DAM
                    PROBABLE MAXIMUM FLOOD PMF/UNIT GRAPH BY SNYDERS METHOD

                                        JOB SPECIFICATION
                      NQ      NHR     NMIN     IDAY      IHR     IMIN    METRC     IPLT     IPRT    NSTAN
                     200        0        5        0        0        0        0        0       -4        0
                                         JOPER      NWT    LROPT    TRACE
                                             5        0        0        0
```

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 2 NRTIO= 1 LRTIO= 1

RTIOS= 0.35

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH FOR KENNAMETAL RESERVOIR DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.20	0.0	1.20	0.0	0.0	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	24.00	102.00	120.00	130.00	0.0	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA
TP= 1.91 CP=0.45 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 1.91 HOURS, CP= 0.45 VOL= 0.91

2.	6.	12.	20.	29.	38.	49.	60.	71.	83.
96.	108.	121.	133.	144.	153.	162.	170.	176.	181.
185.	187.	188.	186.	181.	177.	172.	167.	163.	158.
154.	150.	146.	142.	138.	134.	131.	127.	124.	120.
117.	114.	111.	108.	105.	102.	99.	97.	94.	92.
89.	87.	84.	82.	80.	78.	76.	74.	72.	70.
68.	66.	64.	62.	61.	59.	58.	56.	54.	53.
52.	50.	49.	48.	46.	45.	44.	43.	41.	40.
39.	38.	37.	36.	35.	34.	33.	32.	32.	31.
30.	29.	28.	28.	27.	26.	25.	25.	24.	23.

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	24.96	23.08	1.88	191668.
										(634.)	(586.)	(48.)	(5427.44)

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING AT KENNAMETAL RESERVOIR DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME
ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.0	0.0	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	9.	-1

STAGE	1496.80	1497.00	1497.20	1497.40	1497.60	1497.80	1498.00	1498.20	1498.40	1498.60
	1498.30	1499.30	1499.80	1500.30	1500.80	1501.30	1501.80	1502.30		
FLOW	0.0	9.70	27.30	53.00	85.30	123.20	168.30	217.30	268.00	318.70
	374.50	524.90	690.00	869.60	1062.40	1267.70	1484.70	1712.90		

SURFACE AREA=	0.	1.	11.	17.
CAPACITY=	0.	9.	135.	408.
ELEVATION=	1464.	1495.	1520.	1540.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
1496.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1498.6	3.1	1.5	210.

CREST LENGTH	40.	60.	160.	220.	230.
AT OR BELOW ELEVATION	1498.6	1499.0	1500.0	1501.4	1510.0

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
180.	0.50	1478.60	2.00	1496.80	1502.00

PEAK OUTFLOW IS 858. AT TIME 17.50 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
180.	0.50	1478.60	2.00	1496.80	1499.60

BEGIN DAM FAILURE AT 17.17 HOURS

PEAK OUTFLOW IS 1181. AT TIME 17.21 HOURS

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

MOD PULS ROUTING FROM DAM TO STATION THREE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME
ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.0	0.0	1	1	0	0	0

NORMAL DEPTH CHANNEL ROUTING

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	0.	0

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
0.0700	0.0300	0.0700	1165.0	1300.0	8000.	0.04000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.0 1300.00 1000.00 1180.00 1300.00 1170.00 1300.00 1165.00 1310.00 1165.00
1310.00 1170.00 1400.00 1200.00 2000.00 1300.00

STORAGE	0.0	26.48	283.17	766.46	1356.07	2050.33	2866.57	3815.20	4896.72	6111.73
	7458.44	8938.65	10551.74	12297.73	14176.61	16188.39	18333.07	20610.64	23021.09	25564.44
OUTFLOW	0.0	1964.27	21653.86	87654.81	198003.37	353547.56	555697.75	814982.50	1136350.00	1524846.00
	1985425.00	2522915.00	3142018.00	3847298.00	4643228.00	5534169.00	6524377.00	7618018.00	8819202.00	10131925.0
STAGE	1165.00	1172.11	1179.21	1186.32	1193.42	1200.53	1207.63	1214.74	1221.84	1228.95
	1236.05	1243.16	1250.26	1257.37	1264.47	1271.58	1278.68	1285.79	1292.89	1300.00
FLOW	0.0	1964.27	21653.86	87654.81	198003.37	353547.56	555697.75	814982.50	1136350.00	1524846.00
	1985425.00	2522915.00	3142018.00	3847298.00	4643228.00	5534169.00	6524377.00	7618018.00	8819202.00	10131925.0

MAXIMUM STAGE IS 1168.1

MAXIMUM STAGE IS 1168.5

HYDROGRAPH ROUTING

MOD PULS ROUTING FROM STATION THREE TO STATION FOUR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

CLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.0	0.0	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELMVT	ELMAX	FLWTH	SEL
0.0700	0.0300	0.0700	1030.0	1200.0	6000.	0.02000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.0 1200.00 1000.00 1140.00 1100.00 1035.00 1100.00 1030.00 1115.00 1030.00
1115.00 1035.00 1200.00 1140.00 2000.00 1200.00

STORAGE									
0.0	20.38	57.15	113.35	188.97	284.03	398.51	532.42	685.76	858.53
1050.72	1262.34	1493.39	1821.41	2466.75	3442.89	4749.83	6387.57	8356.11	10655.45
OUTFLOW									
0.0	2939.53	10335.45	22763.82	40943.53	65577.56	97342.81	136890.81	184849.37	241825.81
308408.75	385169.75	472665.31	498661.12	610355.50	819951.44	1133006.00	1563811.00	2128092.00	2841457.00
STAGE									
1030.00	1038.95	1047.89	1056.84	1065.79	1074.74	1083.68	1092.63	1101.58	1110.53
1119.47	1128.42	1137.37	1146.31	1155.26	1164.21	1173.16	1182.10	1191.05	1200.00
FLOW									
0.0	2939.53	10335.45	22763.82	40943.53	65577.56	97342.81	136890.81	184849.37	241825.81
308408.75	385169.75	472665.31	498661.12	610355.50	819951.44	1133006.00	1563811.00	2128092.00	2841457.00

MAXIMUM STAGE IS 1032.6

MAXIMUM STAGE IS 1033.0

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 0.35
HYDROGRAPH AT	1	1.20 (3.11)	1	859. (24.31)
			2	859. (24.31)
ROUTED TO	2	1.20 (3.11)	1	858. (24.31)
			2	1006. (28.48)
ROUTED TO	3	1.20 (3.11)	1	853. (24.14)
			2	981. (27.78)
ROUTED TO	4	1.20 (3.11)	1	852. (24.11)
			2	975. (27.61)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1496.80	1496.80	1498.60
STORAGE	11.	11.	14.
OUTFLOW	0.	0.	319.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.35	1499.65	1.05	16.	858.	7.00	17.50	0.0

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1496.80	1496.80	1498.60
STORAGE	11.	11.	14.
OUTFLOW	0.	0.	319.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.35	1499.61	1.01	16.	1181.	2.50	17.21	17.17

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.35	853.	1168.1	17.67

PLAN 2 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.35	981.	1168.5	17.58

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.35	852.	1032.6	17.83

PLAN 2 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.35	975.	1033.0	17.75

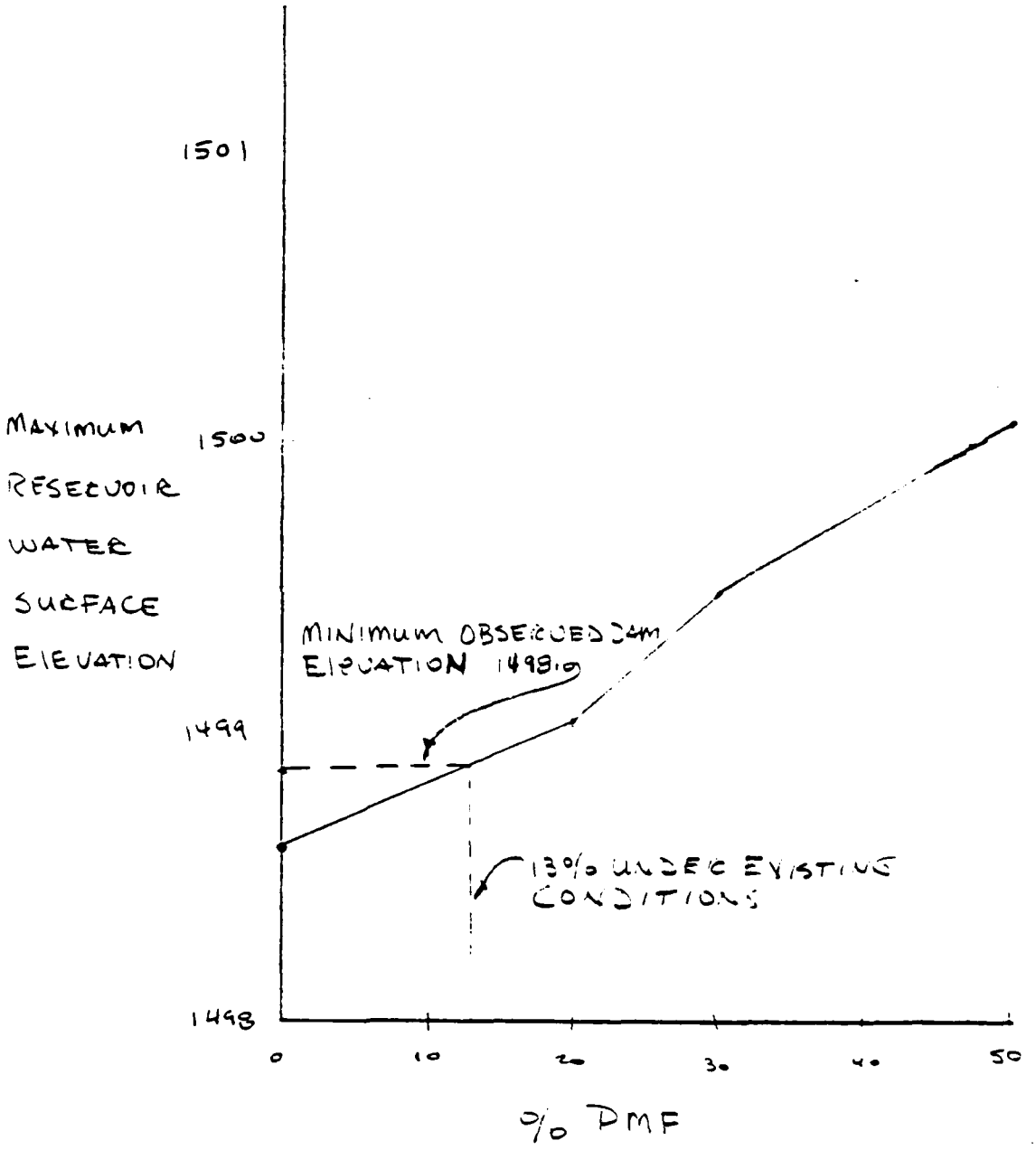
ACKENHEIL & ASSOCIATES
GEO Systems, Inc.
1000 Banksville Road
PITTSBURGH, PA. 15216
(412) 531-7111

Sheet _____ of _____

Job KINZUA DAM RESERVOIR Job No. 79153-E

Subject SPILLWAY / RESERVOIR RATING CURVE

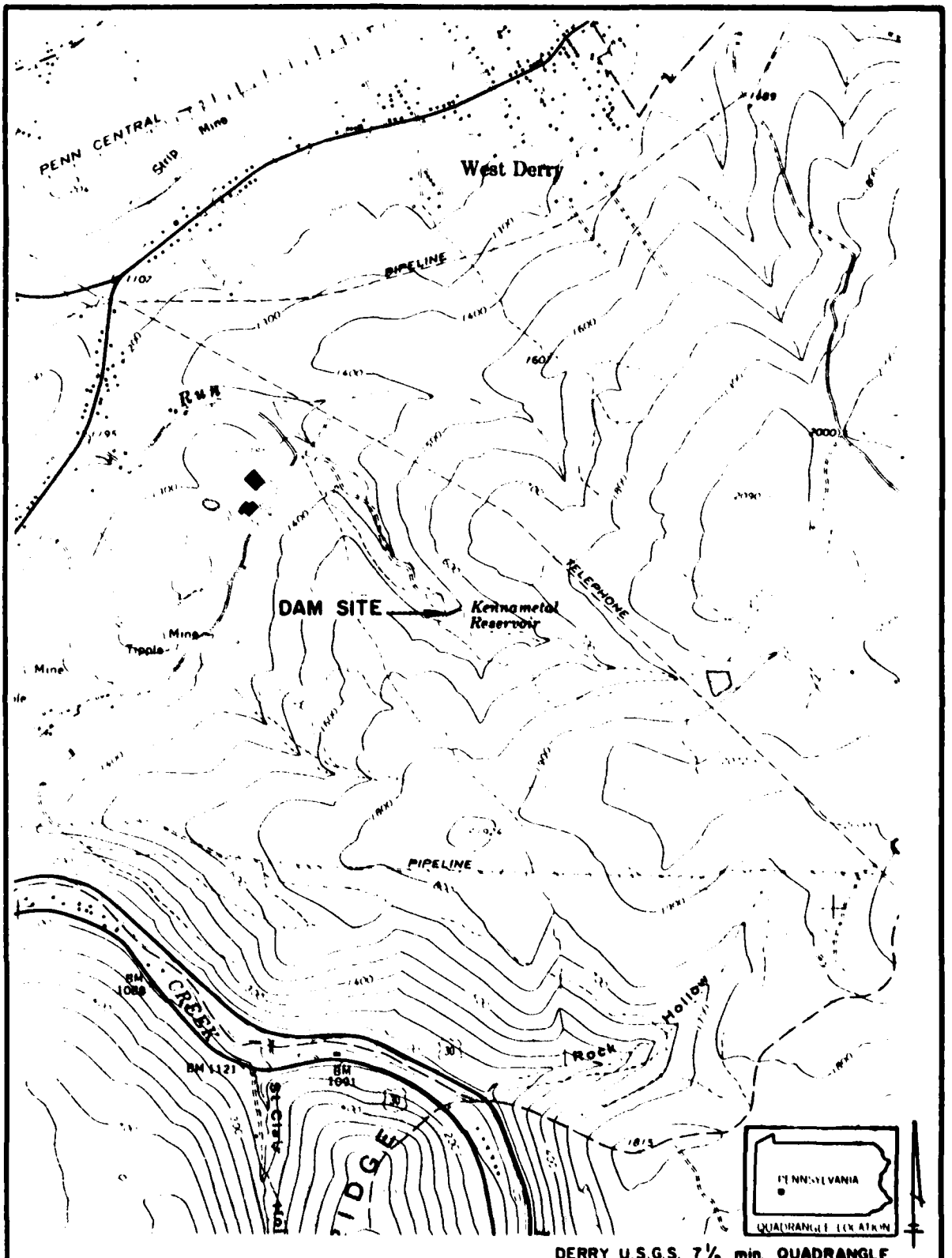
Made By VDH Date 4/26/80 Checked EHB Date 4/29/80



APPENDIX E

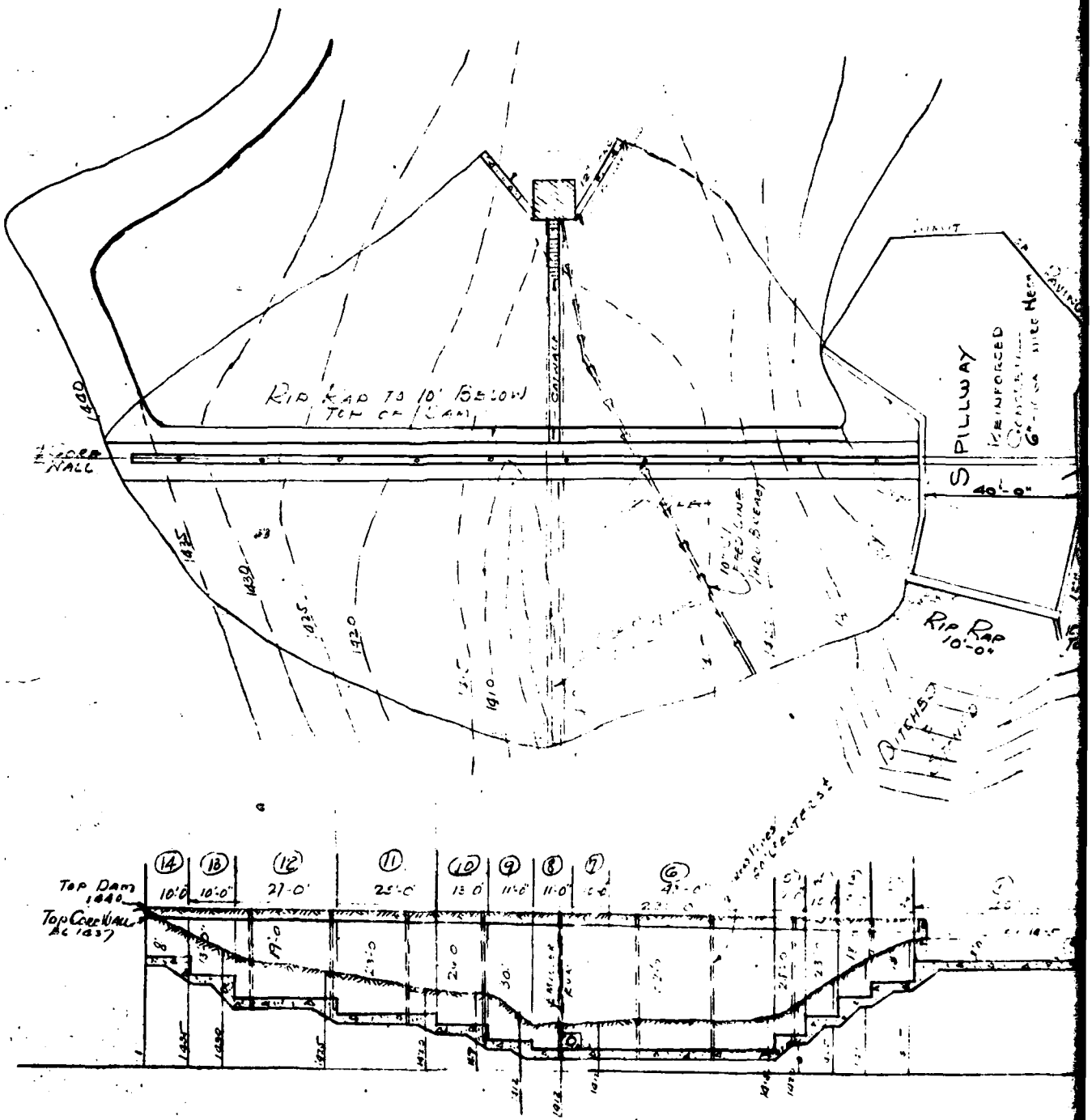
PLATES

LIST OF PLATES

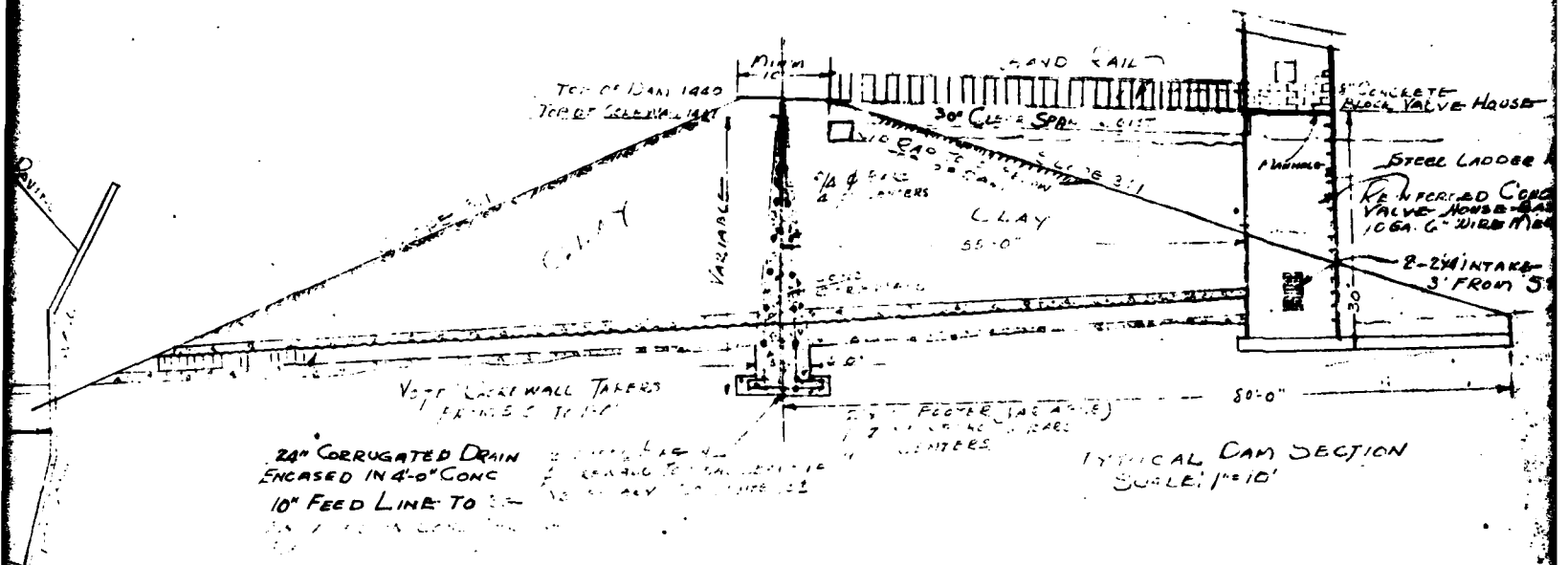


DERRY U.S.G.S. 7½ min. QUADRANGLE

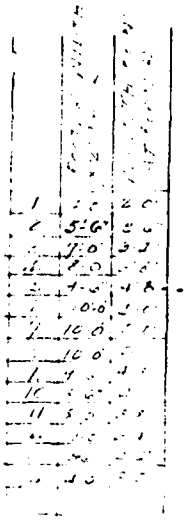
DATE: MAY 1980	KENNAMETAL RESERVOIR DAM NATIONAL DAM INSPECTION PROGRAM		REGIONAL VICINITY MAP
SCALE: 1" = 2000'			
DR: JF	CK:	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	
DWG. NO. PLATE I			



LONGITUDINAL SECTION
PROPOSED MILLER RUN
DERRY TWP WESTMORELAND CO.
FOR
KENNA BETA INC.
SCALE 1"=20' JUNE 1957



TYPICAL DAM SECTION
SCALE: 1"=10'



RESERVOIR
CO [illegible]

2

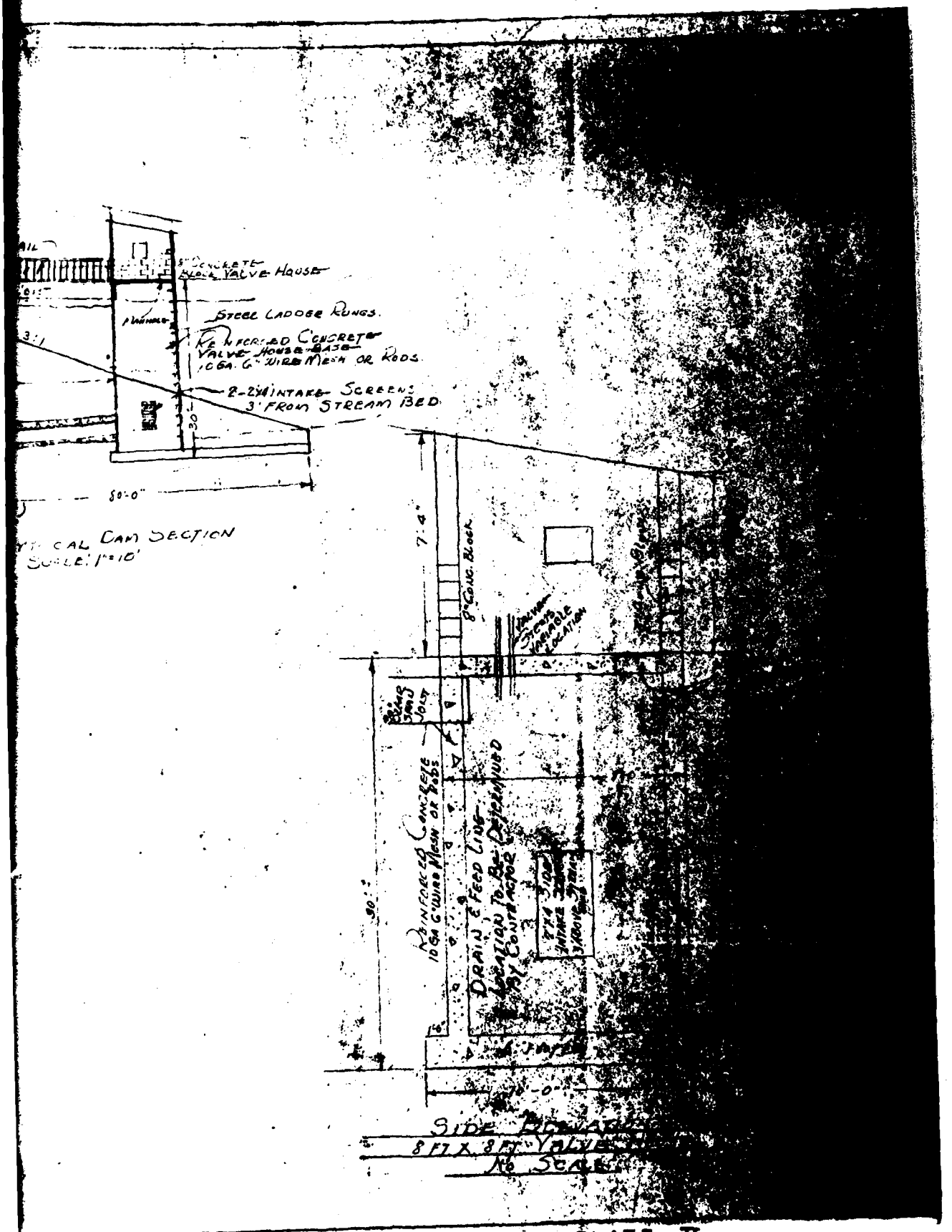
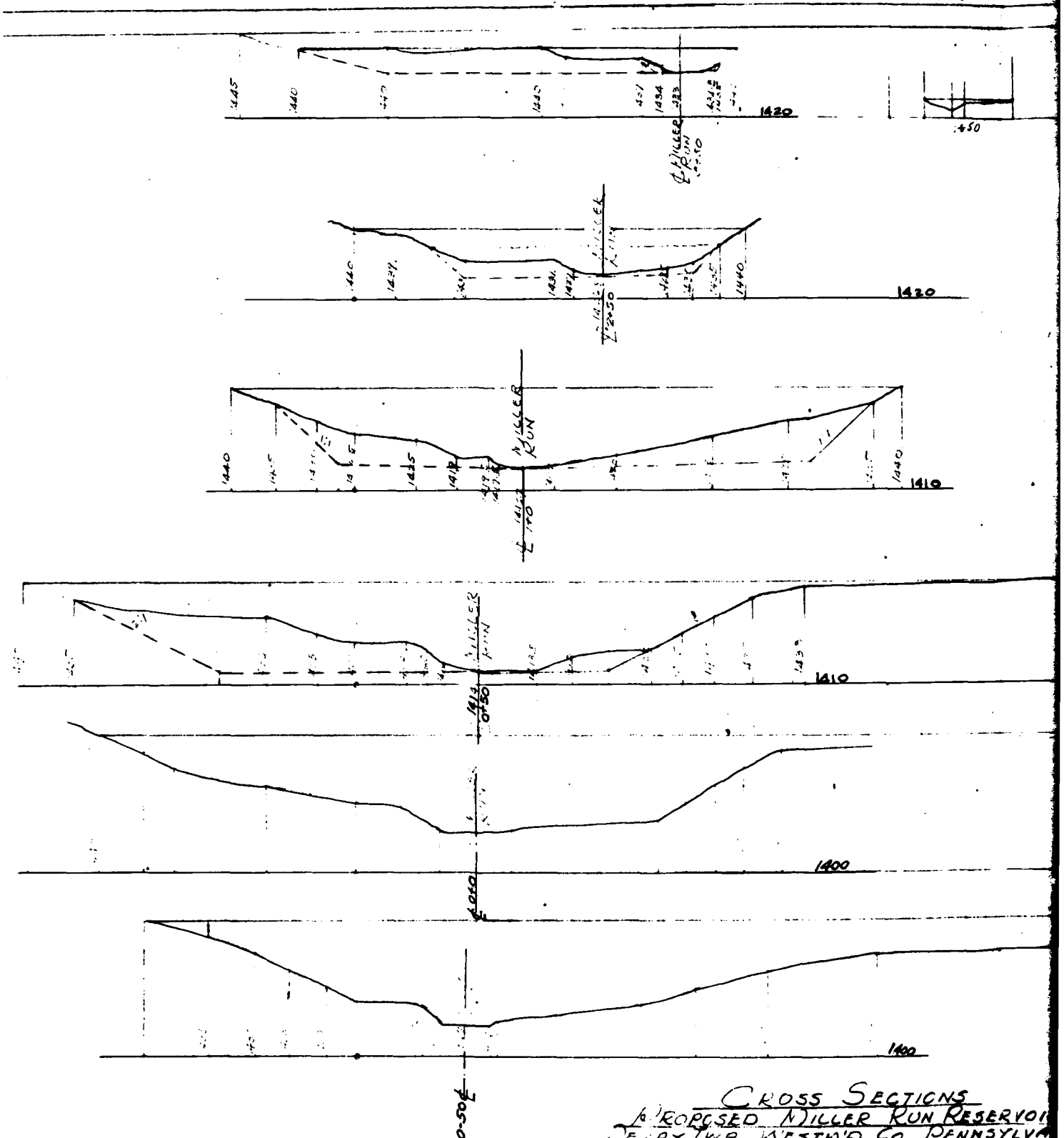

STEEL LADDER RUNGS.
REINFORCED CONCRETE VALVE HOUSE BASE
10 GA. 6" WIRE MESH OR RODS.
2-2½" INTAKE SCREENS 3' FROM STREAM BED.
80'-0"
TYPICAL DAM SECTION
SCALE: 1"=10'
8" CONC. BLOCK
REINFORCED CONCRETE 10 GA 6" WIRE MESH OR RODS
DRAIN & FEED LINE LOCATION TO BE DETERMINED BY CONTRACTOR
SIDE BOARD
8 FT. X 8 FT. VALVE
No SCALE

PLATE II



CROSS SECTIONS

PROPOSED MILLER RUN RESERVOIR

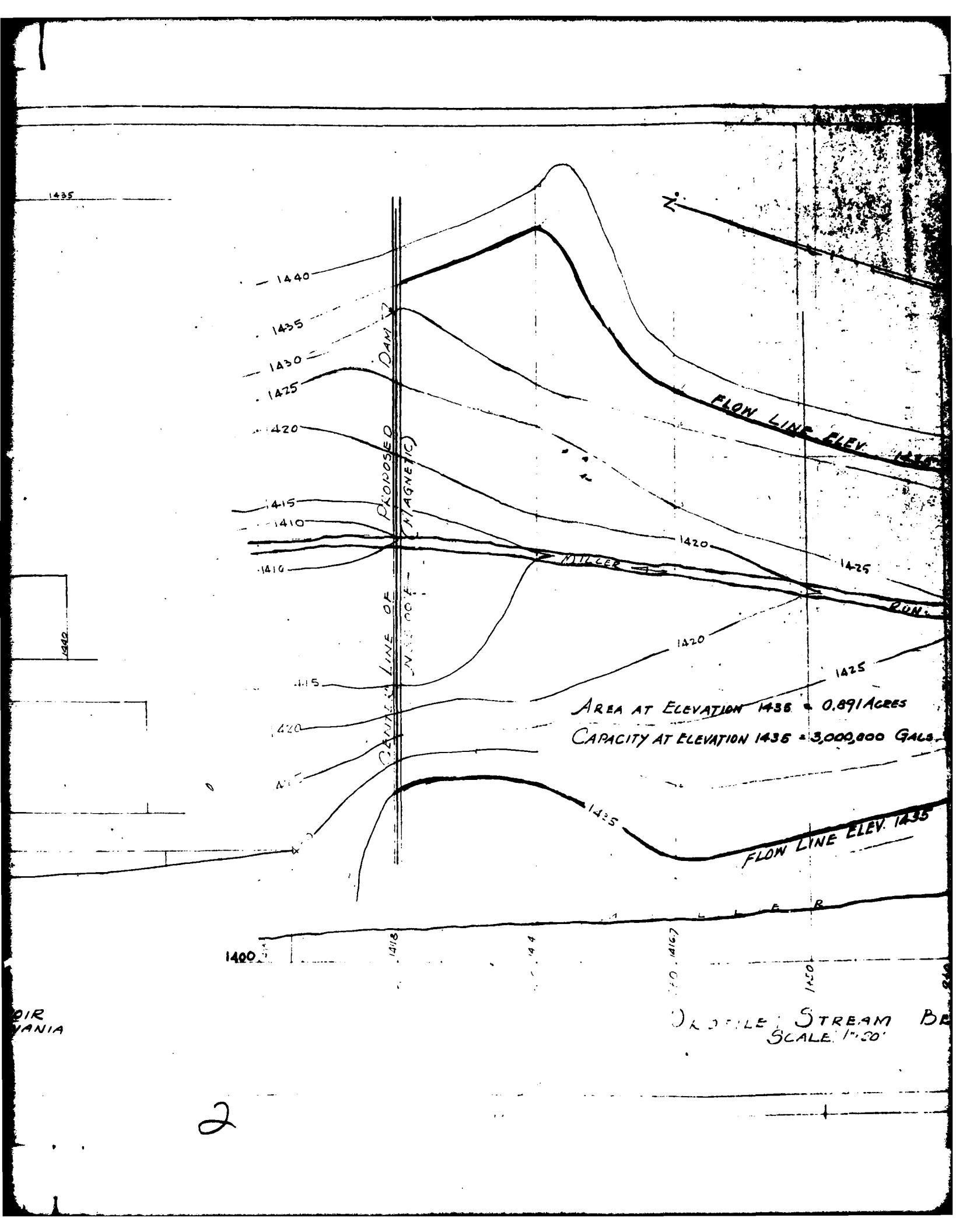
DERRY TWP. WESTM'D. CO PENNSYLVANIA

FOR

KENNA METALS INC.

LATROBE, PA

SCALE 1"=20' VERT. & HORIZ


1435
1440
1435
1430
1425
1420
1415
1410
1410
PROPOSED DAM
(MAGNETIC)
CENTER LINE OF
1420
1425
MILLER
RUN
1420
1425
1415
1420
1435
FLOW LINE ELEV. 1435
AREA AT ELEVATION 1436 = 0.891 ACRES
CAPACITY AT ELEVATION 1436 = 3,000,000 GALS.
1400
1418
1420
STREAM
SCALE 1"=20'

2

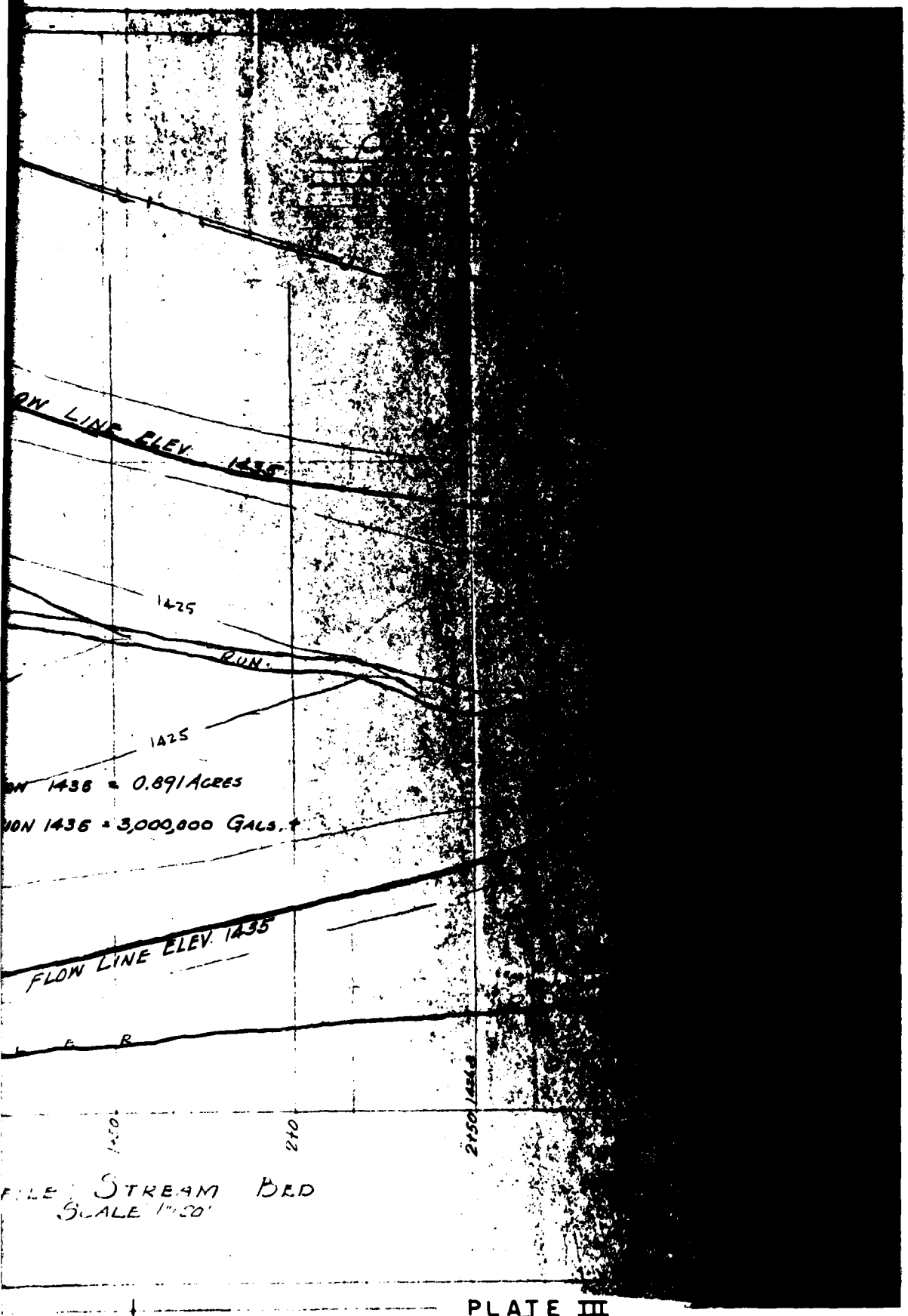

OW LINE ELEV. 1436
1425
RUN.
1425
ON 1436 = 0.891 ACRES
ION 1436 = 3,000,000 GALS.±
FLOW LINE ELEV. 1435
E R
1450
210
2150
STREAM BED
SCALE 1"=20'

PLATE III

APPENDIX F

GEOLOGY

GEOLOGY

Geomorphology

Physiographic Province: Kennametal Reservoir Dam is located along Miller Run on the west flank of Chestnut Ridge. The rocks which underlie this site are part of the Allegheny Mountain section of the Appalacian Plateau physiographic province. The Allegheny Mountain section is characterized by elongated anticlinal ridges trending about N30°E, that have a local relief of as much as 1500 feet.

Local Features: The valley walls immediately above the dam are strewn with massive sandstone blocks. These blocks are believed to have slid down the hillside after the underlying supportive shale beds had been weathered away.

Structure

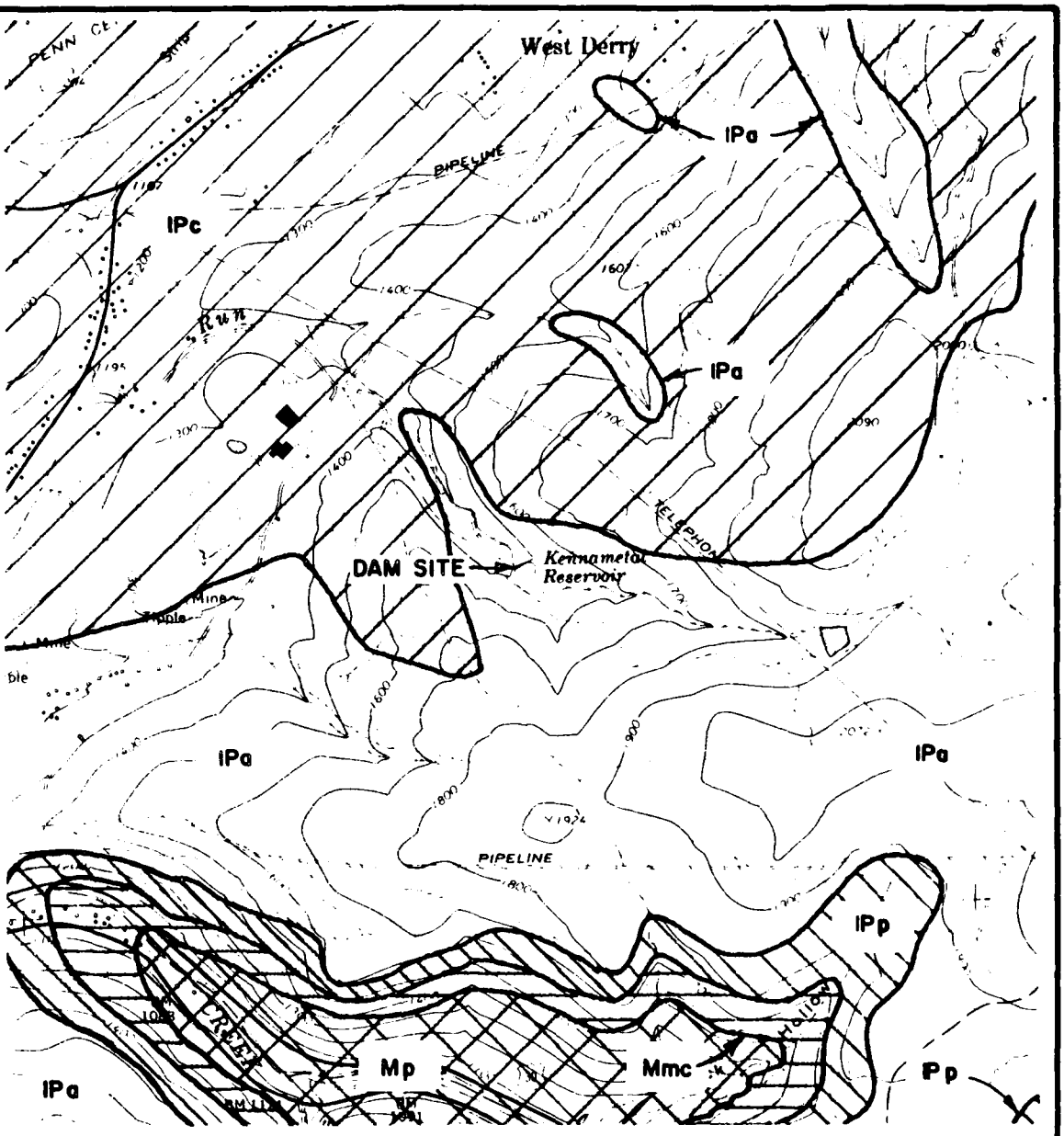
Chestnut Ridge is a NE-SW trending anticlinal fold. According to estimates obtained from the Greater Pittsburgh Region Structure Contour Map the strata in the vicinity of Kennametal Dam strike at N42°E and dip about 6° to the northwest.

Faulting: A normal fault striking NE-SW and dipping steeply to the east extends for at least 2 miles along the east flank of Chestnut Ridge. This fault was noted on the Greater Pittsburgh Region Structure Contour Map of Allegheny, Armstrong, Beaver, Butler, Washington and Westmoreland Counties. The southern limit of the fault is approximately 4 miles northeast of Kennametal Dam. No others were noted on this geologic map, nor were any observations made which would indicate faulting in the rocks that outcrop around the dam site.

Stratigraphy

General: Rocks on the hillside of Kennametal Reservoir Dam belong primarily to the Kittanning and overlying Freeport Formations, Allegheny Group of Pennsylvanian Age.

Immediate Vicinity of Dam: Bedrock in the immediate vicinity of Kennametal Dam is the Upper Worthington Sandstone Member, Kittanning Formation, Allegheny Group. The Upper Worthington Sandstone Member consists of a light brown to light gray, coarse grained, quartz rich sandstone. It often contains streaks or clasts of black carbonaceous material.



DERRY QUADRANGLE, WESTMORELAND COUNTY, PENNSYLVANIA

SCALE: 0 1/2 MILE 1:24000

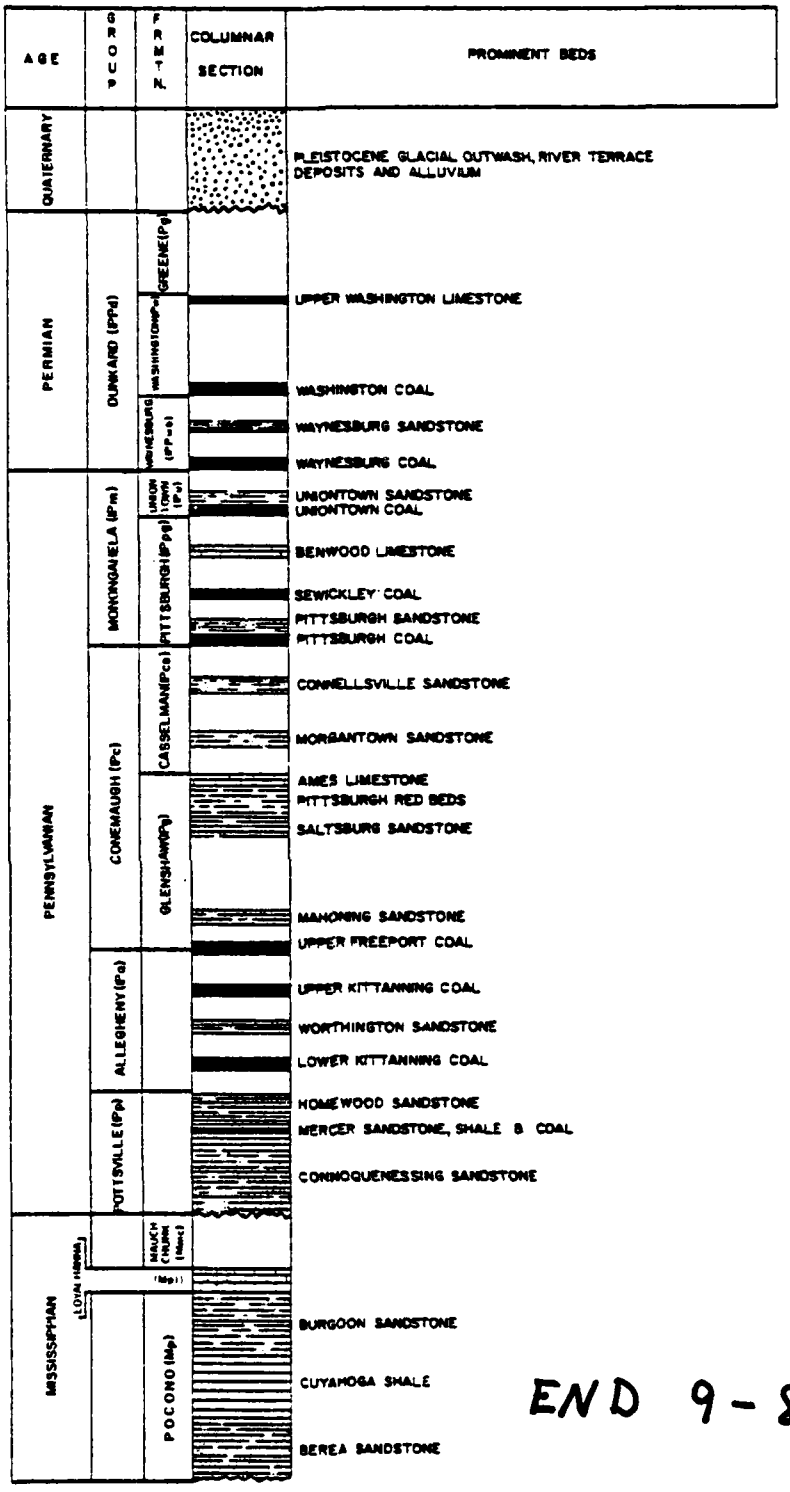
CONTOUR INTERVAL 20 FT. DATUM IS MEAN SEA LEVEL

FORMATION CONTACT

DATA OBTAINED FROM PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY GREATER PITTSBURGH REGION GEOLOGIC MAP AND CROSS SECTIONS, 1975 and GREATER PITTSBURGH REGION STRUCTURE CONTOUR MAP, 1975

DATE: MAY 1980		KENNAMETAL RESERVOIR DAM NATIONAL DAM INSPECTION PROGRAM	GEOLOGIC MAP
SCALE: 1" = 2000'			
DR:	CK:	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	

10 7100 ALBANENE A. & B. SMITH CO., PGH., PA.



END 9-80

DATE: MAY 1980	KENNAMENTAL RESERVOIR DAM NATIONAL DAM INSPECTION PROGRAM
SCALE: NONE	
DR: JF CK: JPH	A. C. ACKENHEIL & ASSOCIATES, INC CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE MD

10 7169 ALBANENE A. & B. SMITH CO., PGH., PA.